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Arisaema wangmoense (Araceae), a New Species from China

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ABSTRACT. A new species of *Arisaema* Mart. (Araceae) is described and illustrated from Wangmo County, Guizhou Province, China. The relationship between *A. wangmoense* M. T. An, H. H. Zhang & Q. Lin and related taxa is discussed. The new species is distinguished by its obtuse cataphylls, petiolulate leaflets, serrulate or denticulate margins, and stipitate appendix.

Key words: Araceae, *Arisaema*, China, Guizhou, IUCN Red List.

The genus *Arisaema* Mart. (Araceae) consists of ca. 180 species and is distributed in northeastern Africa, the Arabian Peninsula, Asia, eastern North America, and Mexico. Seventy-seven species are reported to occur in China (Li et al., 2010).

Within Guizhou Province, many limestone hills distinguish Wangmo County. During fieldwork in Wangmo County in southwestern Guizhou, southwestern China, in April and May 2009, a previously unknown species belonging to *Arisaema* sect. *Sinarisaema* Nakai (Nakai, 1950) was collected on limestone rocks. This species was found to be distinctive when compared with related taxa. For comparison, *Arisaema* specimens were examined at CDBI, GZAC, GZTM, HGAS, HIB, HNNU, IBK, IBSC, KUN, LBG, NAS, PE, SYS, and SZ. The new species is described and illustrated herein. In addition, living plants were collected and cultivated in the greenhouse at the Forestry College of Guizhou University during April and May 2009.

Arisaema wangmoense M. T. An, H. H. Zhang & Q. Lin, sp. nov. TYPE: China. Guizhou: Wangmo Co., Lewang, Shuijingwan, 1100 m, 8 May 2009 (♂), *M. T. An & T. L. Wei 2009-999* (holotype, GZAC). Figure 1.

Haec species *Arisaemati consanguineo* Schott et *A. erubescenti* (Wall.) Schott affinis, sed ab eis cataphyllis apice obtusis (non acutiusculis), foliolis petiolulatis (non sessilibus) margine serrulatis vel denticulatis (non integris vel undulatis) atque spadicis masculae appendice stipitata (non sessili) differt.

Plants dioecious; tuber depressed-globose, 2–3.5 cm diam., stolons absent; cataphylls 3, to 22 cm, greenish white, with brown striae and red spots,

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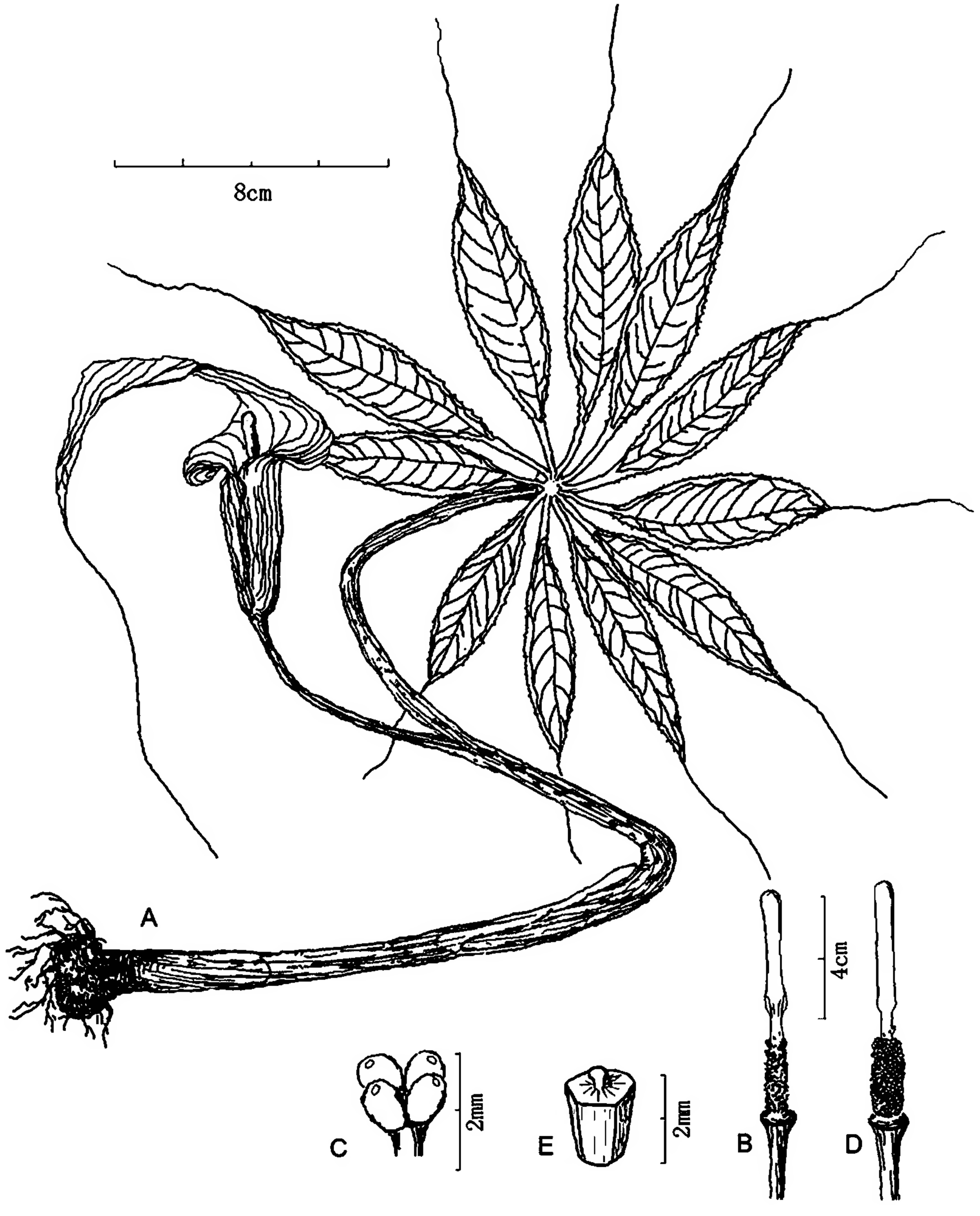

Figure 1. *Arisaema wangmoense* M. T. An, H. H. Zhang & Q. Lin. —A. Habit of staminate plant. —B. Inflorescence, showing the staminate stage. —C. Male flower. —D. Inflorescence, showing the pistillate stage. —E. Ovary. A–C from the holotype, *M. T. An & T. L. Wei 2009–999* (GZAC); D, E from the paratype, *M. T. An & T. L. Wei 2009–1001* (GZAC). Drawn by Chao Yang.

obtuse at apex. Leaf solitary; petiole 40–60 cm, 7–9 mm diam., the leaf sheathing in the lower 20 cm; leaf blade radiate; leaflets 7 to 13, petiolulate, with petiolule 1–2 cm, dull green with impressed veins adaxially, green with raised veins abaxially, narrowly elliptic, lanceolate, or oblanceolate, 7–22 × 1.5–2.5 cm, base attenuate or cuneate, apex long acuminate or caudate, with a filiform extension to 5–8 cm, margins serrulate or denticulate; lateral veins numerous, pinnate and obliquely ascending. Fertile peduncle shorter than petiole, 20–50 cm, the free portion 5–7 cm from pseudostem; spathe greenish white, with or without indistinct whitish stripes; spathe tube cylindric, 4.5–7 cm, recurved at mouth;

Table 1. Comparison of morphological characteristics of *Arisaema wangmoense* and related taxa.

Characters	*A. wangmoense*	*A. consanguineum*	*A. erubescens*
Cataphylls	3, greenish white, to 22 cm, obtuse at apex	3, dark green, to 55 cm, somewhat acute at apex	3, dark green, to 15 cm, somewhat acute at apex
Leaf	solitary; petiole 40–60 cm	solitary; petiole to 100 cm	solitary; petiole 12–30 cm
Leaf blade	radiate; leaflets petiolulate (petiolule 1–2 cm), narrowly elliptic, lanceolate, or oblanceolate, 7–22 × 1.5–2.5 cm, margins serrulate or denticulate, apex with a filiform extension	radiate; leaflets sessile, narrowly elliptic or narrowly linear, 16–28 × 0.6–3.5 cm, margins entire, apex with a filiform extension	radiate; leaflets sessile, oblanceolate to narrowly oblanceolate, 5–15 × 0.6–3 cm, margins undulate, apex without a filiform extension
Spathe	tube cylindric, recurved at mouth; limb 5–8 cm; apex with a filiform tail 7–15 cm	tube cylindric, recurved at mouth; limb 8–12 cm; apex with a filiform tail 5–35 cm	tube narrowly cylindric, slightly recurved at mouth; limb ca. 10 cm; apex with a long filiform tail
Male spadix	flowering portion cylindric, 2.5–3.5 cm; appendix with 6–8 mm stipe	flowering portion cylindric, 4–4.5 cm; appendix sessile	flowering portion cylindric, 2.5–3.5 cm; appendix sessile
Female spadix	female portion ca. 3 cm	female portion ca. 3.5 cm	female portion ca. 3.5 cm
Berries	red	red	red
Infructescence	erect	nodding	erect

spathe limb green, sometimes with purple margin, pale green inside, triangular-ovate, 5–8 × 2.5–5.5 cm, apex acuminate with long filiform tail 7–15 cm, pendulous; spadix functionally unisexual; staminate flowers 1; flowering portion cylindric, 2.5–3.5 cm, ca. 3 mm diam.; rachis green; anthers subsessile, 2 to 4; appendix erect, stipitate, with the stipe 6–8 mm, pale green, cylindric, 3–4 cm, 2–3 mm diam., smooth, obtuse at apex; female spadix with the pistillate portion conic, ca. 3 cm; ovaries green, obovoid; stigma subsessile, orbicular. Berries red; appendix pale green, cylindrical, ca. 4 cm; infructescence erect.

Distribution and habitat. *Arisaema wangmoense* is only known from the type locality in Wangmo County, Guizhou Provice, southwestern China. This species was observed to grow among limestone rocks at an altitude of 1100 m.

IUCN Red List category. *Arisaema wangmoense* seems to be rare and restricted in distribution and should be considered Critically Endangered (CR) according to IUCN Red List criteria (IUCN, 2001).

Phenology. *Arisaema wangmoense* was observed in flower from April to May and in fruit from June to September.

Discussion. *Arisaema wangmoense* is a member of *Arisaema* sect. *Sinarisaema* based on the depressed-globose tubers, the solitary leaf with radiate segments, the recurved spathe limb, the unisexual spadix, the cylindric appendix, and the anthers that dehisce by apical pores. This new species appears to be closely related to *A. consanguineum* Schott and *A. erubescens* (Wall.) Schott, but differs from them by having cataphylls obtuse at the apex (vs. somewhat acute), leaflets with a petiolule 1–2 cm long (vs. sessile), serrulate or denticulate blade margins (vs. entire), an appendix with a stipe 6–8 mm long (vs. sessile), and an erect infructescence (vs. nodding or erect) (Table 1).

Paratypes. CHINA. **Guizhou:** Wangmo Co., Lewang, Shuijingwan, 1100 m, 24 Apr. 2009 (♂), *M. T. An 2009-410* (MO), 8 May 2009 (♀), *M. T. An & T. L. Wei 2009-1001* (GZAC).

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Taxonomic Notes on the *Genista ephedroides* Group (Fabaceae) from the Mediterranean Area

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Abstract. A revision of the taxa belonging to the *Genista ephedroides* group (Fabaceae, Cytiseae) occurring in the Tyrrhenian area is presented. The study, carried out on the basis of the literature, herbarium material, and field and karyological investigations, allows the recognition of 13 taxa. Eight are already known: *G. cilentina* Vals., *G. demarcoi* Brullo, Scelsi & Siracusa, *G. dorycnifolia* Font Quer, *G. ephedroides* DC., *G. gasparrinii* (Guss.) C. Presl, *G. numidica* Spach, *G. tyrrhena* Vals., and *G. valsecchiae* Brullo & De Marco, and five are new to science. *Genista bocchierii* Bacch., Brullo & Feoli Chiapella, *G. insularis* Bacch., Brullo & Feoli Chiapella, *G. insularis* subsp. *fodinae* Bacch., Brullo & Feoli Chiapella, and *G. ovina* Bacch., Brullo & Feoli Chiapella are described from Sardinia, Italy, while *G. tyrrhena* subsp. *pontiana* Brullo & De Marco is described from the Pontine Archipelago of Latium, Italy. Karyologically, most of the taxa are characterized by the somatic number $2n = 48$ (*G. bocchierii*, *G. cilentina*, *G. demarcoi*, *G. dorycnifolia*, *G. gasparrinii*, *G. tyrrhena* subsp. *tyrrhena*, *G. ephedroides*, *G. valsecchiae*, *G. insularis*), with accessory chromosomes occasionally yielding higher counts. In addition to $2n = 48$, the new report of $2n = 44$ is noted for the new species *G. ovina*. A new count of $2n = 48$ is reported for *G. tyrrhena* subsp. *tyrrhena*, whereas higher counts ($2n = 48 + 0$–2B, 72, 96) are reported for the new subspecies *G. tyrrhena* subsp. *pontiana*. For each examined taxon, notes are given on the nomenclature, karyology, ecology, and chorology, while a detailed iconography is lacking only for *G. numidica* and *G. dorycnifolia*. An analytical key for the *G. ephedroides* group is presented. Lectotypes are designated for *G. numidica* and *Spartium gymnopterum* Viv.

Key words: Fabaceae, *Genista*, *Genista ephedroides* group, IUCN Red List, Mediterranean.

A contribution to the taxonomical investigations on the genus *Genista* L. (Fabaceae, Cytiseae) focused on the taxa belonging to the *G. ephedroides* group is presented. According to Valsecchi (1986a, 1986b, 1993a, 1993b), De Marco et al. (1987), Brullo et al. (1993), Brullo and De Marco (1996), Estabrook (2001), De Castro et al. (2002), and Pardo et al. (2004), the species so far known within this group are: *G. cilentina* Vals., *G. demarcoi* Brullo, Scelsi & Siracusa, *G. dorycnifolia* Font Quer, *G. ephedroides* DC., *G. gasparrinii* (Guss.) C. Presl, *G. numidica* Spach, *G. tyrrhena* Vals., and *G. valsecchiae* Brullo & De Marco. On the basis of the literature, as well as herbarium and field investigations, these taxa are morphologically well distinguished from the other Mediterranean species of *Genista*. According to Spach (1844) and Valsecchi (1993b), the *G. ephedroides* group must be referred to *Genista* sect. *Ephedrospartum* Spach, which includes unarmed and ephedriform shrubs with 1- to 3-foliolate leaves, long racemose and many-flowered inflorescences, and entire and caducous bracts and bracteoles.

The morphological study was carried out mostly on living material collected during field investigations, as well as on herbarium specimens from various herbaria (BC, BM, C, CAG, CAT, FI, G, LG, M, NAP, OXF, P, PAL, RO, TO, TSB, W, WU).

These investigations revealed other taxa that are morphologically distinct from any known species of the group. Like the previously recognized taxa within the *Genista ephedroides* group, the new taxa are distributed in the central Mediterranean area, predominantly in the Tyrrhenian area. In particular, *G. ephedroides*, *G. valsecchiae*, and three new species are circumscribed to Sardinia; *G. gasparrinii* and *G. demarcoi* occur in Sicily; both the autonymic subspecies of *G. tyrrhena* and one new subspecies occur in the Aeolian and Pontine Islands, respec-

 doi: 10.3417/2009026

tively; *G. cilentina* occurs in southern Italy; *G. dorycnifolia* is found in Ibiza (Balearic Islands); and *G. numidica* occurs in northeastern Algeria.

From a phytogeographic point of view, the Tyrrhenian area represents a very important area of the Mediterranean basin, because it is a speciation center for many plant groups associated with Tertiary floras (Braun-Blanquet, 1926; Favarger & Contandriopoulos, 1961; Cardona & Contandriopoulos, 1979; Arrigoni, 1983). According to the distribution of the taxa of the *Genista ephedroides* group, three main centers of speciation were identified: the southeastern Tyrrhenian coast (Sicily and southern Italy), the southwestern Tyrrhenian islands (Ibiza and Sardinia), and Maghreb (Algeria). In particular, a significant concentration of taxa has been observed in southwestern Sardinia (Sulcis-Iglesiente sector), where *G. valsecchiae*, *G. bocchierii* Bacch., Brullo & Feoli Chiapella, *G. insularis* Bacch., Brullo & Feoli Chiapella subsp. *insularis*, and *G. ovina* Bacch., Brullo & Feoli Chiapella occur. This area is unique from a floristic point of view mainly for its palaeogeographic history (Bacchetta, 2006; Bacchetta et al., 2007). Many endemics grow in this sector, as other species of *Genista*: *G. arbusensis* Vals., *G. sulcitana* Vals., and *G. morisii* Colla (Valsecchi, 1976, 1984, 1986a), all localized on siliceous substrates (granite, metamorphic, and volcanic rock). In southwestern Sardinia, diverse other species of *Genista* are present, as *G. sardoa* Vals., endemic to the western coastal zone; *G. aetnensis* (Biv.) DC., endemic to Sardinia and Mount Etna in Sicily; *G. corsica* (Loisel.) DC., endemic to Sardinia and Corsica; and *G. ferox* Poir., distributed in Algeria, Tunisia, and the western zone of Sardinia (Arrigoni & Vannelli, 1967; Valsecchi, 1977, 1981, 1984). In the southeastern Tyrrhenian area, the species of *Genista* (*G. cilentina*, *G. gasparrinii*, *G. demarcoi*, *G. tyrrhena* subsp. *tyrrhena*, and its new subspecies) show a very scattered distribution and are localized on different substrates (limestone, metamorphic, and volcanic rock). Other endemic species of *Genista* grow on the siliceous substrates of the Tyrrhenian slope of Sicily, as *G. aristata* C. Presl, *G. cupani* Guss., and *G. madoniensis* Raimondo (Gibbs, 1966; Raimondo, 1999). The third center for the *G. ephedroides* group can be found in Algeria, where *G. numidica* grows, which can be considered a separate and distinct species complex. In fact, additional taxa closely related to this species have been described by Pomel (1874) at the species level (*G. ischnoclada* Pomel, *G. sarotes* Pomel, *G. filiramea* Pomel), and these names were successively considered by Battandier (1919) and Maire (1987) as subspecies of *G. numidica*. Unfortunately, it is impossible to clarify the taxonomic relationships of these taxa, because the present sociopolitical situation of Algeria does not permit field investigations for the collection of living material necessary to check the morphological characters and the variability of the populations. Other endemic species of *Genista* grow in Algeria, sometimes reaching the neighboring zone of Tunisia, as *G. vepres* Pomel, *G. microcephala* Coss. & Durieu, *G. spinulosa* Pomel, and *G. ulicina* Spach (Quezel & Santa, 1962; Maire, 1987). Most likely, the *G. ephedroides* group derives from a common ancestor that had a wide distribution throughout the southern Tyrrhenian area. As a consequence of the geographical isolation and the different ecologies here, speciation triggered the differentiation of numerous taxa.

The karyological investigation was carried out on seeds collected in the field. Voucher specimens of seeds are deposited in CAG, CAT, and TSB. Mitotic phases were observed from root tips of seedlings, pretreated with 8-hydroxyquinoline, fixed in a 1:3 solution of glacial acetic acid:absolute ethanol (Carnoy's fluid), hydrolyzed in 1N HCl at 60°C for 6 min., and stained using the routine Feulgen method, with slides prepared by the squash technique.

The *Genista ephedroides* group is quite homogeneous from a karyological point of view: the same somatic chromosome number $2n = 48$ was counted in nine taxa (*G. bocchierii*, *G. cilentina*, *G. demarcoi*, *G. dorycnifolia*, *G. gasparrinii*, *G. tyrrhena* subsp. *tyrrhena*, *G. ephedroides*, *G. valsecchiae*, and *G. insularis*), sometimes with two or four accessory chromosomes. Different counts were made only for *G. ovina* ($2n = 44$), while for *G. tyrrhena* subsp. *pontiana* Brullo & De Marco, in addition to $2n = 48$, counts of $2n = 72$ or $2n = 96$ were also made. The number $2n = 48$ traces back to the basic number $x = 12$, which is by far the most common secondary basic number in *Genista* and in other genera of the Cytiseae (Sañudo, 1979; Cusma Velari & Feoli Chiapella, 1994; Cusma Velari et al., 2003). All the taxa of the *G. ephedroides* group are therefore tetraploid.

I. Genista L., Sp. Pl. 2: 709–711. 1753. TYPE: *Genista tinctoria* L.

Species in the *Genista ephedroides* group include: *G. cilentina*, *G. demarcoi*, *G. dorycnifolia*, *G. ephedroides*, *G. gasparrinii*, *G. numidica*, *G. tyrrhena*, and *G. valsecchiae*. Five new taxa are proposed in this paper, including two new subspecies and three new species. Based on their ephedriform habit, 1- to 3-foliolate leaves, long and many-flowered inflorescences, and entire and caducous bracts and bracte-

oles, all the new taxa described here clearly belong to *Genista* sect. *Ephedrospartum*.

The new species described from southern Sardinia are closely related to *Genista valsecchiae* and *G. ephedroides*. In particular, *G. ovina* seems to be morphologically more strongly differentiated from these taxa because it is characterized by a compact and pulvinate habit; well-developed bracts; ovate-triangular bracteoles; a corolla with longer wings and shorter keel; longer, elliptical-lanceolate, rounded, and not apiculate anthers; and sometimes an aneuploid chromosome complement ($2n = 44$). *Genista insularis* is well differentiated from the other Sardinian species belonging to this group by its longer bracts, retuse standard, and shortly nerved calyx. Within this species, we recognize two morphologically and ecologically well-differentiated taxa, which are here treated at subspecific level. They are *G. insularis* subsp. *insularis* and *G. insularis* subsp. *fodinae* Bacch., Brullo & Feoli Chiapella. The latter can be distinguished from the type in having larger bracts and flowers, linear-subulate bracteoles, and smaller anthers, as well as by its exclusive localization on metalliferous substrates. Finally, *G. bocchierii* is very peculiar because it is characterized by a habit that typically tends to the arborescent form, bracts and bracteoles that are very narrow and long apiculate, and calyx teeth that are narrowly triangular-subulate and long apiculate. This species is also differentiated ecologically by growing very near the sea on loose substrates. Within *G. tyrrhena*, we recognize the new subspecies *pontiana*, which is differentiated from the type in having longer bracts, shorter and narrower bracteoles, a calyx with thin veins and shorter teeth, and buds with wings exserted from the standard. On the other hand, both subspecies share some characters, such as the long and many-flowered inflorescences, the calyx with straight lower lip teeth, the rounded and apiculate standard, the apiculate anthers 1.2–1.4 mm long, and the legume longer than 8 mm. Furthermore, both subspecies grow on volcanic substrates but have allopatric distribution ranges.

KEY TO THE SPECIES OF THE *GENISTA EPHEDROIDES* GROUP

1a. Calyx 2–3 mm long with lips subequal, 1–1.8 mm long; calyx teeth triangular, obtuse.
2a. Leaves 3–7 mm long; bracts 2.5–2.7 mm long; bracteoles subulate; standard retuse at the apex, 5–7 mm long; wings 6–7 mm long with glabrous lateral lobe ..... *G. gasparrinii*
2b. Leaves 8–18 mm long; bracts 1–1.2 mm long; bracteoles ovate; standard rounded at the apex, 8–8.5 mm long; wings 8–9.5 mm long with a tuft of hairs on the lateral lobe ..... *G. dorycnifolia*
1b. Calyx 3–7 mm long with lips unequal, 1.8–4.2 mm long; calyx teeth linear to ovate-triangular, acute to acuminate.
3a. Lower lip of the calyx with central tooth shorter than the lateral ones; standard with short apiculum at the apex; legume 8–11 mm long.
4a. Bracteoles lanceolate to ovate, 2–4.5 mm long; lower lip of the calyx 2.5–4 mm long, with teeth 0.8–2 mm long ..... *G. tyrrhena* subsp. *tyrrhena*
4b. Bracteoles lanceolate-subulate to subulate, 1.8–2 mm long; lower lip of the calyx 2–2.7 mm long, with teeth 0.7–1 mm long ..... *G. tyrrhena* subsp. *pontiana*
3b. Lower lip of the calyx with central tooth longer than the lateral ones or subequal; standard without apiculum at the apex; legume 5–8 mm long.
5a. Bracteoles 2–3 mm long; calyx 5.5–6.5 mm long; wings with a notably ciliate, lateral furrow ..... *G. cilentina*
5b. Bracteoles 0.5–1.5(–2) mm long; calyx 3–5 mm long; wings without a ciliate lateral furrow.
6a. Lower lip of the calyx with central tooth much longer than the lateral ones; anthers 0.5–0.75 mm long, aristate; legume 5.5–6 mm long ..... *G. numidica*
6b. Lower lip of the calyx with teeth subequal or with the central one slightly longer than the lateral ones; anthers 0.8–1.3 mm long, apiculate or rounded; legume 7–8 mm long.
7a. Standard retuse at the apex.
8a. Pulvinate shrub, 30–80 cm tall; bracts 1.5–2.5 mm long; bracteoles subulate, 1.5–2 mm long; calyx with lower lip teeth 0.8–1.5 mm long ..... *G. demarcoi*
8b. Erect shrub, 100–200 cm tall; bracts 3.5–6.5 mm long; bracteoles lanceolate or triangular-lanceolate, 1.2–1.5 mm long; calyx with lower lip teeth 0.4–0.8 mm long.
9a. Bracts linear, 3.5–4 mm long; calyx 3.5–4 mm long; standard 6.5–7 mm long; wings 6.5–7 mm long; keel 8–8.5 mm long; anthers 1.2–1.3 mm long ..... *G. insularis* subsp. *insularis*
9b. Bracts oblong-linear, 5–6.5 mm long; calyx 4–4.5 mm long; standard 8–9 mm long; wings 7.5–8.5 mm long; keel 9–10 mm long; anthers ca. 1 mm long ..... *G. insularis* subsp. *fodinae*
7b. Standard rounded or obtuse at the apex.
10a. Branches contracted; standard 6–6.5 mm long, obtuse at the apex ..... *G. valsecchiae*
10b. Branches loose; standard 7–8 mm long, rounded at the apex.

11a. Bracts triangular-lanceolate, 1–3 mm long; wings 5.5–6.2 mm long ..... *G. ephedroides*
11b. Bracts oblong-linear to linear-subulate, 2.5–4.5 mm long; wings 7–8 mm long.
12a. Pulvinate shrub, 30–60 cm tall; bracteoles ovate-triangular; calyx with lower lip 3–3.5 mm long; anthers elliptical, rounded at apex ..... *G. ovina*
12b. Erect shrub, 100–300 cm tall; bracteoles linear-subulate; calyx with lower lip 1.8–2 mm long; anthers ovate-lanceolate, apiculate ..... *G. bocchierii*

1. Genista bocchierii Bacch., Brullo & Feoli Chiapella, sp. nov. TYPE: [Italy. Sardinia:] Santa Margherita di Pula, Pula (CA), depositi alluvionali quaternari, 9 June 1998, *G. Bacchetta & S. Brullo s.n.* (holotype, CAT; isotypes, CAG, CAT, FI). Figures 1A$_4$, B$_4$, 3A$_6$, B$_6$.

Haec species a *Genista valsecchiae* Brullo & De Marco habitu arborescenti usque ad 300 cm alto, ramis flexuosis acutis inermibus, bracteolis lineari-subulatis, calycis labio inferiore 1.8–2 mm longo, dentibus erectis 1–1.2 mm longis, vexillo ad apicem rotundato 7–8 mm longo 6–6.5 mm lato, alis ca. 7.5 mm longis, carina ca. 8.5 mm longa atque alis in alabastro e vexillo leviter exsertis differt.

Erect shrub to arborescent, robust, lax, 100–300 cm tall, with branches flexuous, alternate or subclustered, acute at the apex, striate, pubescent. Leaves 3-foliate, uppermost often simple, sessile, linear-lanceolate, revolute, sericeous, 2–10 mm, caducous. Inflorescence ± dense, 2.5–5 cm, 5- to 12-flowered; bracts linear-subulate, long apiculate, 2.5–4 mm, slightly longer than the pedicel; bracteoles linear-subulate, long apiculate, 1.2–1.5 mm, inserted at calyx base. Calyx sericeous, conic-campanulate, 3.5–4 mm, with veins incrassate and decurrent only in the lip, lower lip longer than the upper, 1.8–2 × 1.5–1.8 mm, with teeth subequal, triangular-subulate, erect, 1–1.2 mm, upper lip with teeth 1-nerved, triangular-subulate, apiculate, 1.5–1.8 mm; floral buds with wings exserted from the standard; corolla yellow; standard ovate-cordate, rounded at the apex, 7–8 × 6–6.5 mm, sericeous on the back; wings ca. 7.5 mm, with a tuft of hairs on basal gibbosity; keel ca. 8.5 mm, sericeous on outer faces; anthers ovate-lanceolate, apiculate, 1–1.1 mm. Legume totally pubescent, ovate-beaked, 8 mm.

Chromosome number. $2n = 48$ (Pula, San Margherita di Pula, Km 38.750 [Cagliari], 16 Mar. 1997, *G. Bacchetta s.n.* [TSB], new count).

Distribution and ecology. *Genista bocchierii* is known only from San Margherita di Pula, near Cagliari in southwestern Sardinia, where it grows on granitic sands and alluvial substrates at altitudes from 0 to 30 m. It is a component of acidophilous maquis vegetation and represents the dominant shrub. The bioclimate is Mediterranean pluviseasonal-oceanic, with thermotype upper thermomediterranean and ombrotype upper dry (Bacchetta, 2006).

IUCN Red List category. *Genista bocchierii* is assessed here as Endangered (EN) according to IUCN Red List criteria (IUCN, 2001, 2003).

Etymology. The species is named in honor of Emanuele Bocchieri (1941–), botanist at Cagliari University.

Paratypes. ITALY. **Sardinia:** Santa Margherita, 6 June 1971, *N. Kaae s.n.* (C); Pula, S. Margherita di Pula, Km 38.750 (Cagliari), 16 Mar. 1997, *G. Bacchetta s.n.* (CAG, TSB); Calaverde, Pula (Cagliari), 18 Apr. 1998, *G. Bacchetta s.n.* (CAG, TSB); Calaverde (Sta. Margherita di Pula), Pula (CA), 18 Apr. 1998, *G. Bacchetta s.n.* (CAG).

2. Genista cilentina Vals., Boll. Soc. Sarda Sci. Nat. 29: 255. 1992 [1993]. TYPE: [Italy. Campania:] Cilento, macchia e rocce alla Torre del Telegrafo, a sud di Ascea, 50–100 m, 26 Mar. 1968, *G. Moggi s.n.* (holotype, FI). Figures 2A$_5$, B$_5$, 3A$_{10}$, B$_{10}$.

Erect shrub, robust, intricate, 50–180 cm tall, with branches rigid, alternate or subclustered, acute at the apex, striate, pubescent. Leaves 3-foliate, uppermost often simple, sessile, linear-lanceolate, revolute, sericeous, 4–13 mm, caducous. Inflorescence ± dense, 3–12 cm, 10- to 35-flowered; bracts triangular-lanceolate to linear-sublanceolate, 3–13 mm, slightly longer than the pedicel; bracteoles linear-subulate, 2–3 mm, inserted at the calyx base. Calyx sericeous, conic-campanulate, 5.5–6.5 mm, with veins thin and decurrent only in the lip, lower lip longer than the upper, 3.5–4.2 × 2.3–3 mm, with teeth unequal, triangular, divaricate, lateral ones 0.5–0.6 mm, central one 1–1.2 mm, upper lip with teeth 1-nerved, ovate-triangular, apiculate, 2–2.2 mm; floral buds with wings shortly exserted from the standard; corolla yellow; standard cordate, retuse at the apex, 8–10 × 7–9 mm, sericeous on the back; wings 8–10 mm, with a tuft of hairs on the basal gibbosity and a lateral furrow notably ciliate; keel 9–

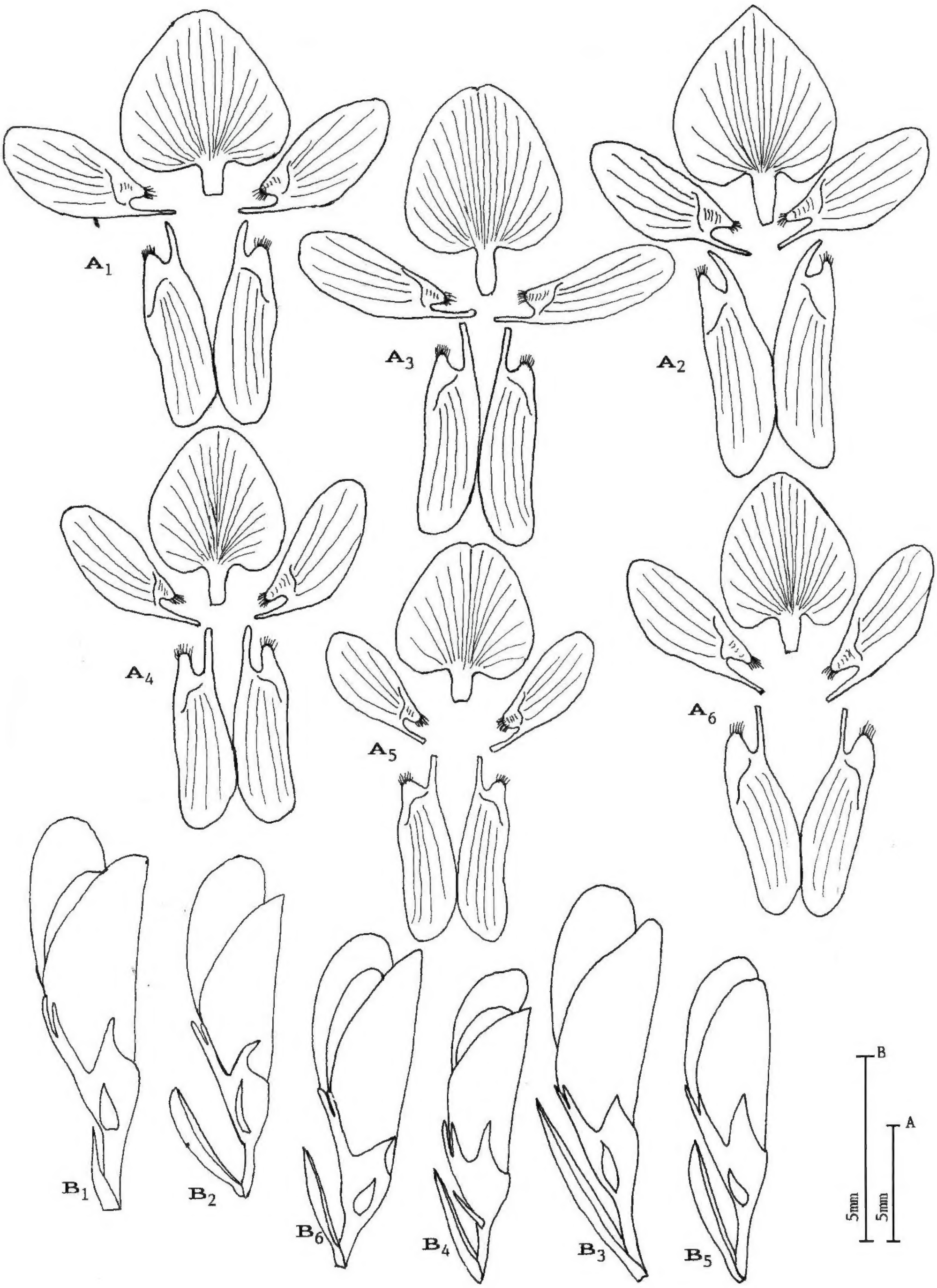

Figure 1. Corolla dissections or segments (A) and floral buds (B). —A_1, B_1. *Genista ephedroides* DC., based on 3 May 1995, *Brullo & De Marco s.n.* (CAT). —A_2, B_2. *G. valsecchiae* Brullo & De Marco, based on the type, 11 May 1994, *Brullo et al s.n.* (CAT). —A_3, B_3. *G. insularis* subsp. *fodinae* Bacch., Brullo & Feoli Chiapella, based on the type, 6 June 2002, *Bacchetta et al. s.n.* (CAT). —A_4, B_4. *G. bocchierii* Bacch., Brullo & Feoli Chiapella, based on the type, 9 June 1998, *Bacchetta & Brullo s.n.* (CAT). —A_5, B_5. *G. insularis* Bacch., Brullo & Feoli Chiapella subsp. *insularis*, based on the type, 7 June 2002, *Bacchetta et al. s.n.* (CAT). —A_6, B_6. *G. ovina* Bacch., Brullo & Feoli Chiapella, based on the type, 9 Mar. 2004, *Bacchetta et al. s.n.* (CAT).

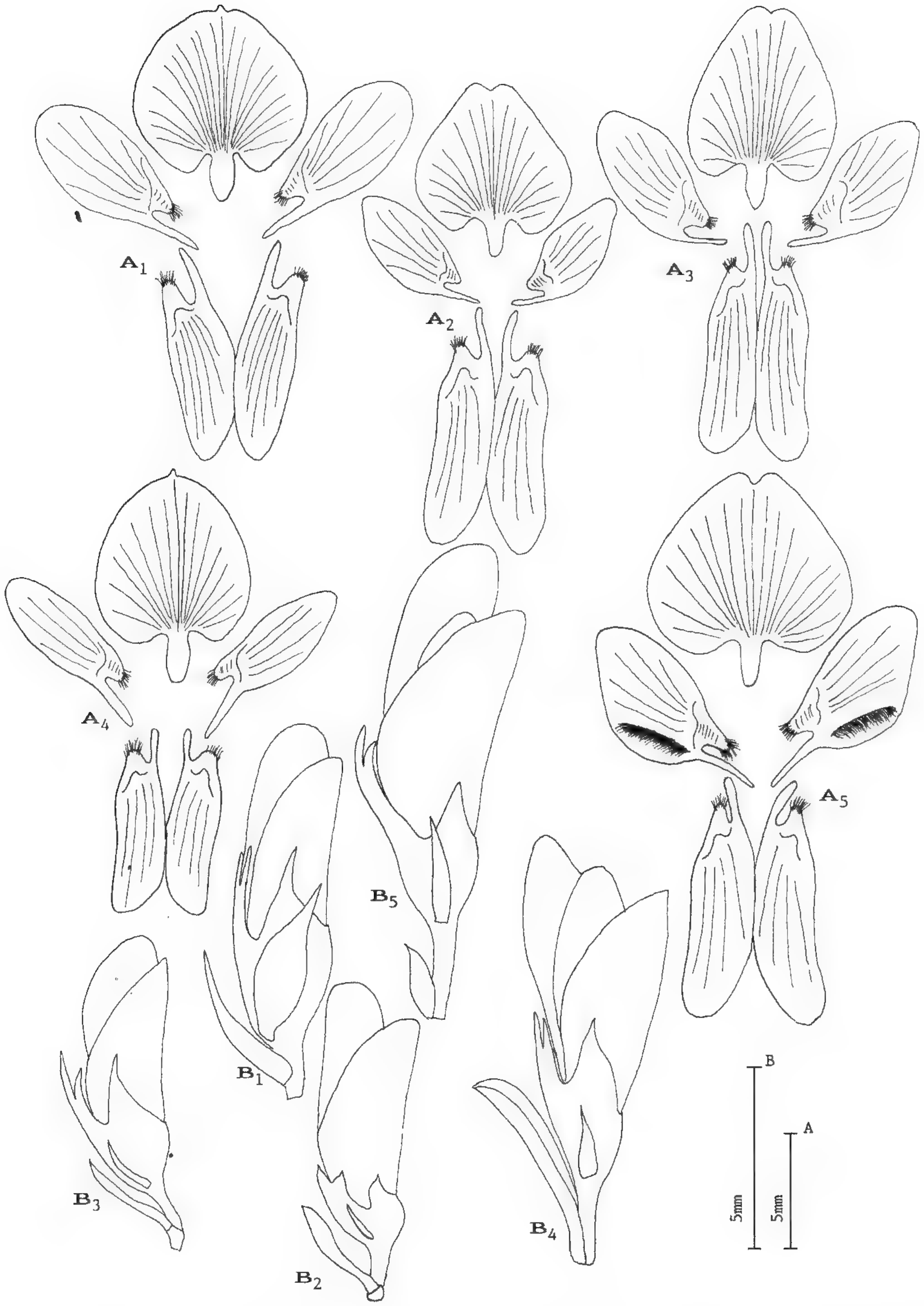

Figure 2. Corolla segments (A) and floral buds (B). —A_1, B_1. *Genista tyrrhena* Vals. subsp. *tyrrhena*, based on 17 June 1992, *Minissale s.n.* (CAT). —A_2, B_2. *G. gasparrinii* (Guss.) C. Presl, based on 24 May 1992, *Scelsi & Siracusa s.n.* (CAT). —A_3, B_3. *G. demarcoi* Brullo, Scelsi & Siracusa, based on the type, 3 June 1992, *Brullo & Scelsi s.n.* (CAT). —A_4, B_4. *G. tyrrhena* subsp. *pontiana* Brullo & De Marco, based on the type, 16 May 1993, *Brullo et al. s.n.* (CAT). —A_5, B_5. *G. cilentina* Vals., based on "Marina di Ascea presso Torre del Telegrafo (Pisciotta)," 16 May 1993, *Brullo et al. s.n.* (CAT).

10 mm, sericeous on the outer faces; anthers ovate, apically obtuse, 0.9–1.1 mm. Legume totally pubescent, ovate-beaked, 5–6 mm.

Iconography. Valsecchi (1993a, fig. 1).

Chromosome number. $2n = 48$ (Marina di Ascea; Pizzolongo, 1961).

Distribution and ecology. *Genista cilentina* is localized in a short stretch of the Cilento coast in southern Italy, where it grows on flysch substrates. It is a component of *Juniperus turbinata* Guss. maquis and acidophilous garigue vegetation at altitudes of 50–200 m. The bioclimate is Mediterranean pluviseasonal-oceanic, with thermotype ranging between upper thermomediterranean and lower mesomediterranean, and ombrotype between upper dry and lower subhumid (Rivas-Martínez, 2007).

IUCN Red List category. *Genista cilentina* has been previously evaluated as Critically Endangered (CR) according to IUCN Red List criteria (Scoppola & Spampinato, 2005).

Additional specimens examined. ITALY. **Campania:** Kampanien, prov. Salerno, ca. 5 km N von Palinuro under Strasse nach Pisciotta, 6 June 1968, *D. Podlech 5555* (M), 6 June 1968, *Haesler 2266* (C); Pisciotta, Golfo di Policastro, 11 May 1983, *G. De Marco s.n.* (CAT), 16 May 1993, *S. Brullo, F. Scelsi & G. Siracusa s.n.* (CAT); Marina di Ascea presso Fiumicello (Pisciotta), 16 May 1993, *S. Brullo, F. Scelsi & G. Siracusa s.n.* (CAT); Marina di Ascea presso Torre del Telegrafo (Pisciotta), 16 May 1993, *S. Brullo, F. Scelsi & G. Siracusa s.n.* (CAT); Cilento (Salerno), 27 July 1997, *D. Puntillo s.n.* (TSB); Cilento, Marina di Ascea, sotto la torre del Telegrafo (Salerno), 24 Apr. 2000, *M. Tretiach s.n.* (TSB).

3. **Genista demarcoi** Brullo, Scelsi & Siracusa, Fl. Medit. 3: 304. 1993. TYPE: [Italy.] Sicilia, rupi di Isnello, 3 June 1992, *S. Brullo & F. Scelsi s.n.* (holotype, CAT; isotypes, CAT, FI, PAL). Figures $2A_3$, B_3, $3A_8$, B_8.

Pulvinate, intricate, 30–80 cm tall, with branches flexuous, slender, alternate or subclustered, obtuse at the apex, striate, sericeous. Leaves 3-foliate, uppermost often simple, sessile, linear-lanceolate, revolute, sericeous, 4–14 mm, caducous. Inflorescence ± dense, 1.5–7 cm, 3- to 11-flowered; bracts linear-subulate, 1.5–2.5 mm, much longer than the pedicel; bracteoles subulate, 1.5–2 mm, inserted at the calyx base. Calyx sericeous, conic-campanulate, 3.5–5 mm, with veins thin and extended almost up to the base, lower lip longer than the upper, 2.5–2.6 × 0.8–1 mm, with teeth unequal, lanceolate-subulate, divaricate, lateral ones 0.8–1 mm, central one 1–1.5 mm, upper lip with teeth 1-nerved, triangular, apiculate, 1.5–2 mm; floral buds with wings wholly covered by the standard; corolla yellow; standard ovate-triangular, subretuse at the apex, 8–9 × 7–8 mm, sericeous on the back; wings 7–9 mm, with a tuft of hairs on the basal gibbosity; keel 10–12 mm, sericeous on the outer faces; anthers ovate, apiculate, ca. 1 mm. Legume sparsely pubescent, subcircular or broadly ovate, 7–8 mm.

Iconography. Brullo et al. (1993, figs. 1, 4A2, 4B2).

Chromosome number. $2n = 48$ (San Maria di Isnello [Palermo], 18 June 1997, *E. Schimmenti s.n.* [TSB], new count).

Distribution and ecology. *Genista demarcoi* is a punctiform endemic species, localized only in the Madonie massif near Isnello in northern Sicily. The species is linked to Mesozoic limestone, growing on cliffs and in rupestrian garigue scrubland at altitudes between 800 and 1000 m. The bioclimate is Mediterranean pluviseasonal-oceanic, with thermotype upper mesomediterranean and ombrotype lower subhumid (Brullo et al., 1996).

IUCN Red List category. *Genista demarcoi* has been previously evaluated as Critically Endangered (CR) according to IUCN Red List criteria (Scoppola & Spampinato, 2005).

Additional specimens examined. ITALY. **Sicily**: Isnello alle Madonie, s.d., *G. Gasparrini s.n.* (NAP-GUSS), *G. Gussone s.n.* (FI); Isnello, 8 July 1830, *A. Todaro s.n.* (PAL), 16 June 1870, *M. Lojacono s.n.* (FI), 1 June 1986, *S. Brullo s.n.* (CAT); Sicilia, 1841, *G. Gussone s.n.* (G); in Sicilia, 1845, *A. Alexander s.n.* (BM); in apricis Nebrodum prope Isnello, 19 June 1855, *A. Huet du Pavillon s.n.* (BM, G, M, OXF); Cefalù, June 1856, *Mandralisca s.n.* (PAL); Pizzo di Pilo, June 1859, *Mandralisca s.n.* (PAL), 9 July 1973, *S. Brullo* (CAT); Madoniarum prope Isnello, 18 June 1873, *G. Strobl s.n.* (G, M); Madonie, 3 June 1902, *H. Ross s.n.* (G); Madonie, Isnello, 5 June 1902, *H. Ross 321* (FI, G, M, WU); Madonie, June 1903, *H. Ross s.n.* (BM, M); Tra Castelbuono e Roccarossa, Madonie, 14 May 1978, *S. Pignatti s.n.* (TSB); Palermo, ca. 22 km S of Cefalù, N side of Isnello, 26 May 1979, *P. H. Davis & B. Sutton 63796* (BM); S. Maria di Isnello (Palermo), 18 June 1997, *E. Schimmenti s.n.* (TSB).

4. **Genista dorycnifolia** Font Quer, Butl. Inst. Catalana Hist. Nat. 20: 46. 1920. *Genista numidica* var. *dorycnifolia* (Font Quer) Knoche, Fl. Balear. 2: 62. 1922. *Genista numidica* subsp. *dorycnifolia* (Font Quer) Knoche ex Colom, Biogeogr. Balear., ed. 2, 1: 186. 1978. TYPE: [Spain. Balearic Islands:] Eivissa [Ibiza], Puig Sirer, 200 m, cara a W, 18 May 1919, *P. Font Quer s.n.* (lectotype, designated by Rosselló & Sáez [2001: 73], BC 13591).

Genista dorycnifolia var. *grosii* Font Quer, Butl. Inst. Catalana Hist. Nat. 20: 48. 1920. *Genista grosii* (Font Quer) Font Quer, Mem. Real Acad. Ci. Barcelona 20: 151. 1927. *Genista dorycnifolia* subsp. *grosii* (Font Quer) Font Quer & Rothm., Schedae Fl. Iber. Select., Cent. II-III: n. 239. 1935. TYPE: [Spain. Balearic Islands:] Eivissa [Ibiza], Sta. Agnès, Cala de les Torretes, 29 May 1918, *Gros s.n.* (lectotype, designated by Rosselló & Sáez [2001: 73], BC 13947).

Erect shrub to arborescent, robust, 70–300 cm tall, with branches lax, flexuous, alternate or subclustered, obtuse at the apex, striate, sericeous. Leaves 3-foliate, uppermost often simple, subsessile, linear to linear-oblong, revolute, sericeous, 8–18 mm, caducous. Inflorescence dense and capitate, 1–2 cm, 5- to 18-flowered; bracts linear-oblanceolate, 1–1.2 mm, longer than the pedicel; bracteoles ovate, 0.6–0.8 mm, inserted at the calyx base. Calyx pubescent, campanulate, 2–3 mm, with veins thin and extended almost up to the base, lower lip subequal to the upper, ca. 1 × 3 mm, with teeth subequal, triangular, obtuse, not divaricate, ca. 0.5 mm, upper lip with teeth 1-nerved, triangular-ovate, obtuse, ca. 1.8 mm; floral buds with wings wholly covered by the standard; corolla yellow; standard ovate, rounded or sometimes emarginate at the apex, 8–8.5 × 5–6 mm, sericeous on the back; wings 8–9.5 mm, with a tuft of hairs on the basal gibbosity; keel 10–13 mm, sericeous on the outer faces; anthers ovate, apiculate, 0.9–1.2 mm. Legume sericeous, ovoid-beaked, 8–9 mm.

Iconography. Talavera (1999, lám. 21).

Chromosome number. $2n = 48$ (Ibiza; Santos, 1944–1945; Cardona & Contandriopoulos, 1983).

Distribution and ecology. *Genista dorycnifolia* is endemic to Ibiza (Balearic Islands), where it grows in garigue scrubland and forests of *Pinus halepensis* Mill. at altitudes of 0–200 m. The bioclimate is Mediterranean pluviseasonal-oceanic, with thermotype lower thermomediterranean and ombrotype lower dry (Rivas-Martínez et al., 1992).

IUCN Red List category. *Genista dorycnifolia* is assessed here as Near Threatened (NT) according to IUCN Red List criteria (IUCN, 2001, 2003).

Additional specimens examined. SPAIN. **Balearic Islands:** Cala d'Hort (Ibiza), 1 Apr. 1990, *M. Herrera Gallastegui* [Société pour l'échange des Plantes vasculaires de l'Europe et du Bassin Méditerranéen] *15209* (TSB).

5. Genista ephedroides DC., Prodr. (DC.) 2: 147. 1825. *Genista ephedroides* DC., Mem. Legum.: 210. [1 Mar.] 1826, nom. illeg. TYPE: [Italy. Sardinia:] Longo Sarda Sardaigne, 1824, *H. A. Soleirol* (lectotype, designated by Valsecchi [1986: 198], G-DC). Figures $1A_1$, B_1, $3A_1$, B_1.

Spartium gymnopterum Viv., App. Fl. Cors. 1825. TYPE: Corsica, s.d., s. coll. [sub *Spartium gymnopterum* Viv., manu Viviani, et manu de Candolle, "mi. Viviani 1826"] (lectotype, designated here, G-DC).

Erect shrub to arborescent, robust, intricate, 100–180 cm tall, with branches flexuous, alternate or subclustered, mucronate at the apex, striate, pubescent. Leaves 3-foliate, uppermost often simple, sessile, linear-lanceolate, revolute, sericeous, 3–10 mm, caducous. Inflorescence ± dense, 4–9 cm, 8- to 16-flowered; bracts triangular-lanceolate, 1–3 mm, subequal to pedicel; bracteoles triangular-lanceolate, 1–1.5 mm, inserted at calyx base. Calyx sericeous, conic-campanulate, 3–4 mm, with veins incrassate and decurrent only in the lip, lower lip longer than the upper, 1.8–2.2 × 1.5–1.8 mm, with teeth subequal, linear-subulate, slightly divaricate, lateral ones 0.7–0.8 mm, central one 0.8–1 mm, upper lip with teeth 1-nerved, ovate-triangular, apiculate, 1.4–1.8 mm. Floral buds with wings exserted from the standard; corolla yellow; standard ovate-cordate, rounded at apex, 7–7.5 × 6–7 mm, sericeous on back; wings 5.5–6.2 mm, with a tuft of hairs on the basal gibbosity; keel 9–9.5 mm, sericeous on the outer faces; anthers ovate-lanceolate, apiculate, 1–1.1 mm. Legume totally pubescent, ovate-beaked, ca. 8 mm.

Iconography. De Candolle (1826, tab. 36); Valsecchi (1986a, fig. 1); Brullo and De Marco (1996, fig. 3).

Chromosome number. $2n = 48$ (Santa Teresa di Gallura; Villa, 1980).

Distribution and ecology. *Genista ephedroides* occurs in Capo Testa and Santa Teresa di Gallura in northeastern Sardinia. It grows on granite substrates in thermophilous garigue vegetation at altitudes between 0 and 60 m. The bioclimate of the coastal area is Mediterranean pluviseasonal-oceanic, with thermotype upper thermomediterranean and ombrotype between upper dry and lower subhumid (Rivas-Martínez, 2007).

IUCN Red List category. *Genista ephedroides* has been previously evaluated as Least Concern (LC) according to IUCN Red List criteria (Scoppola & Spampinato, 2005).

Additional specimens examined. ITALY. **Sardinia:** Sarden, s.d., *M. H. Vahl s.n.* (G-DC); Sardaigne, *J. H. Moris s.n.* (G); "Sardaigne, ...à St. Teresa Gallura," 5 May/26 June 1881, *L. Millet s.n.* (G); Arrondissement de Tempio, Santa Teresa, *E. Reverchon 93* (BM, C, G, WU); Gallura, Capo Testa westlich S. Teresa, *H. Merxmüller & F.*

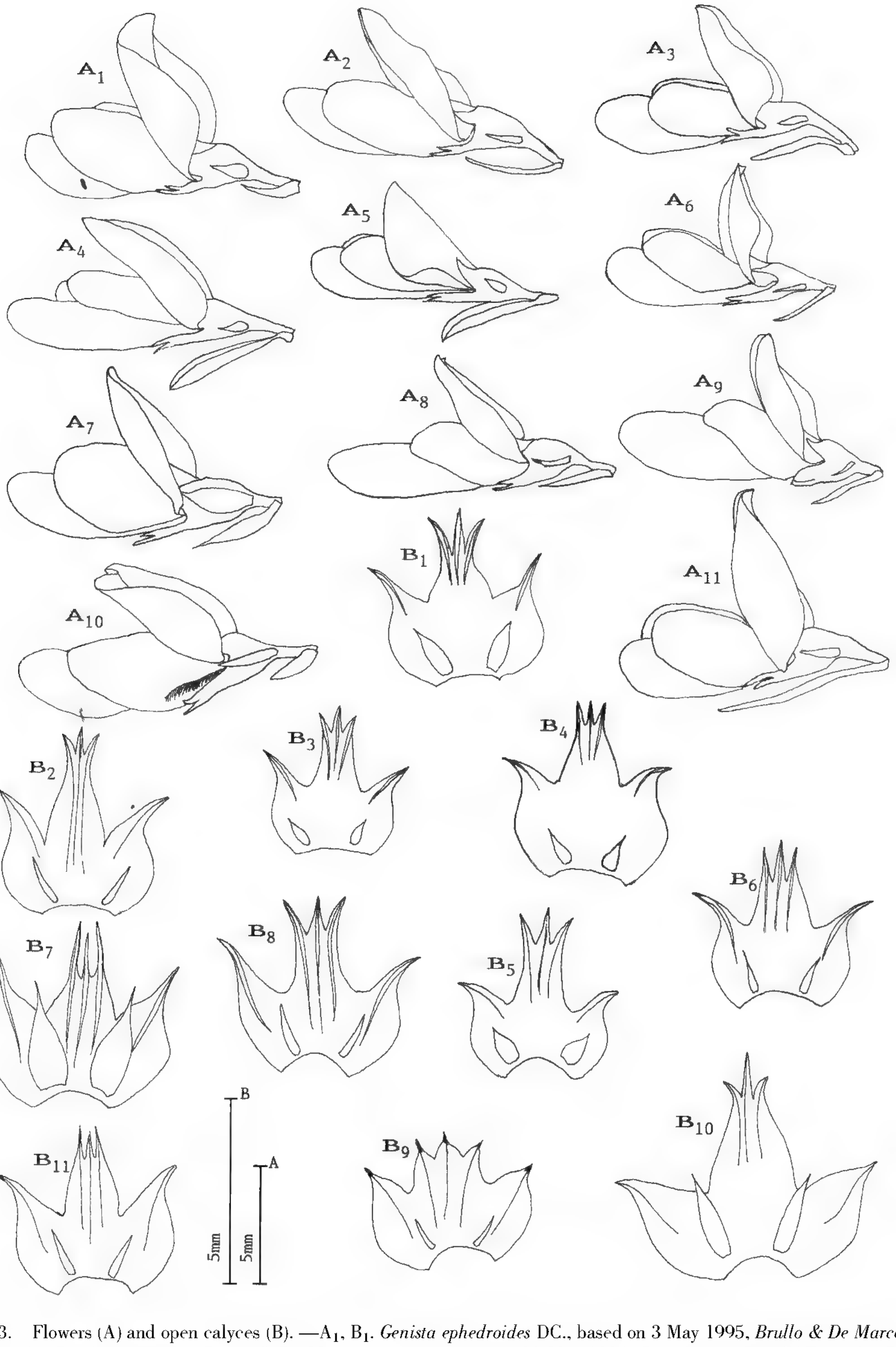

Figure 3. Flowers (A) and open calyces (B). —A_1, B_1. *Genista ephedroides* DC., based on 3 May 1995, *Brullo & De Marco s.n.* (CAT). —A_2, B_2. *G. valsecchiae* Brullo & De Marco, based on the type, 11 May 1994, *Brullo et al. s.n.* (CAT). —A_3, B_3. *G. insularis* Bacch., Brullo & Feoli Chiapella subsp. *insularis*, based on the type, 7 June 2002, *Bacchetta et al. s.n.* (CAT). —A_4, B_4. *G. insularis* subsp. *fodinae* Bacch., Brullo & Feoli Chiapella, based on the type, 6 June 2002, *Bacchetta et al. s.n.* (CAT). —A_5, B_5. *G. ovina* Bacch., Brullo & Feoli Chiapella, based on the type, 9 Mar. 2004, *Bacchetta et al. s.n.* (CAT). —A_6, B_6. *G. bocchierii* Bacch., Brullo & Feoli Chiapella, based on the type, 9 June 1998, *Bacchetta & Brullo s.n.* (CAT). —A_7, B_7. *G. tyrrhena* Vals. subsp. *tyrrhena*, based on 17 June 1992, *Minissale s.n.* (CAT). —A_8, B_8. *G. demarcoi* Brullo, Scelsi & Siracusa, based on the type, 3 June 1992, *Brullo & Scelsi s.n.* (CAT). —A_9, B_9. *G. gasparrinii* (Guss.) C. Presl, based on 24 May 1992, *Scelsi & Siracusa s.n.* (CAT). —A_{10}, B_{10}. *G. cilentina* Vals., based on 16 May 1993, *Brullo et al. s.n.* (CAT). —A_{11}, B_{11}. *G. tyrrhena* subsp. *pontiana* Brullo & De Marco, based on the type, 16 May 1993, *Brullo et al. s.n.* (CAT).

Oberwinkler 20966 (M); Faro S. Teresa (Sassari), 29 May 1970, *F. Valsecchi s.n.* (TSB); Capo Testa (Sassari), 10 May 1971, *S. Pignatti s.n.* (TSB); S. Teresa di Gallura (Sassari), 5 June 1980, *L. Poldini s.n.* (TSB), 6 May 1986, *Schenev s.n.* (M), 16 May 1994, *S. Brullo, G. De Marco & P. Pavone s.n.* (CAT), 3 May 1995, *S. Brullo & G. De Marco s.n.* (CAT), 28 June 2003, *G. Bacchetta & M. Manconi s.n.* (CAG), 12 July 2003, *L. Feoli Chiapella s.n.* (TSB).

6. Genista gasparrinii (Guss.) C. Presl, Fl. Sicul. (Presl) 1: 19. 1826. Basionym: *Spartium gasparrinii* Guss., Ind. Sem. Hort. Boccad. 11. 1825, as "*S. gasparrini*." TYPE: [Italy. Sicily:] asperis et rupibus calcareis, Sferracavallo, s.d., manu *Gussone* (lectotype, designated by Valsecchi [1993b: 810], NAP [Hb. Guss.], sub *Spartium gasparrini*). Figures $2A_2$, B_2, $3A_9$, B_9.

Erect shrub, often compact-pulvinate, intricate, 25–60 cm tall, with branches subrigid, slender, alternate or subclustered, obtuse at the apex, striate, sericeous. Leaves 3-foliate, uppermost often simple, sessile, linear-lanceolate, revolute, sericeous, 3–7 mm, caducous. Inflorescence ± dense, 1–5 cm, 3- to 11-flowered; bracts linear-subulate, leafy, 2.5–2.7 mm, much longer than pedicel; bracteoles subulate, 0.7–1 mm, inserted at calyx base. Calyx sericeous, campanulate, 2.8–3 mm, with veins thin and extended almost to base, lower lip subequal to upper, 1–1.2 × 1.5–2 mm, with teeth subequal, widely triangular, obtuse, apiculate, slightly divaricate, ca. 0.5 mm, upper lip with teeth 1-nerved, widely triangular, obtuse, apiculate, ca. 1 mm; floral buds with wings wholly covered by the standard; corolla yellow; standard ovate-triangular, retuse at apex, 5–7 × 5–7 mm, sericeous on back; wings 6–7 mm, with glabrous lateral lobe; keel 8–10 mm, sericeous on outer faces; anthers ovate, apiculate, ca. 1 mm. Legume sparsely pubescent, subcircular or broadly ovate, 7–8 mm.

Iconography. Brullo et al. (1993, figs. 2, 4A1, 4B1).

Chromosome number. $2n = 48$ (Colombo et al., 1979).

Distribution and ecology. *Genista gasparrinii* is exclusive to Mt. Gallo, near Sferracavallo in northern Sicily. It is a chasmophyte growing on Mesozoic limestone cliffs, near the sea in areas with northern exposures, at altitudes from 50 to 100 m. The bioclimate is Mediterranean pluviseasonal-oceanic, with thermotype upper thermomediterranean and ombrotype upper dry (Brullo et al., 1996).

IUCN Red List category. *Genista gasparrinii* has been previously evaluated as Critically Endangered (CR) according to IUCN Red List criteria (Scoppola & Spampinato, 2005).

Additional specimens examined. ITALY. **Sicily:** Sicile, s.d., *G. Gussone s.n.* (G); Prope Panorme et in insulis relatis, s.d., *G. Gasparrini s.n.* (FI); Sferracavallo, s.d., *G. Gasparrini s.n.* (F); Mt. Gallo presso Palermo, s.d., *G. Gussone s.n.* (FI); Mt. Gallo, 1827, *G. Gasparrini s.n.* (FI), 10 July 1840, *T. Heldreich s.n.* (G), s.d., *A. Todaro s.n.* (WU), Oct. 1848, *A. Todaro* (PAL), May 1856, *A. Huet du Pavillon* (G), *M. Lojacono 477* (BM, G), 1 Oct. 1977, *S. Brullo s.n.* (CAT), 24 May 1992, *F. Scelsi & G. Siracusa s.n.* (CAT); Palermo a Mt. Gallo, s.d., *G. Gussone s.n.* (FI), 16 May 1996, *E. Schimmenti & G. Scafidi s.n.* (TSB); Mt. Gallo, prope Panormum, 1828, *G. Gussone s.n.* (G); Panormi a Sferracavallo, 25 Apr. 1835, *F. Parlatore s.n.* (FI); Mt. Gallo, Sferracavallo, s.d., *F. Parlatore s.n.* (G), 4 July 1992, *F. Scelsi s.n.* (CAT); Palermo a Sferracavallo, 1844, *F. Parlatore s.n.* (G), s.d., *A. Todaro s.n.* (WU), May, *A. Todaro 227* (BM, M, OXF, PAL), *C. C. Lacaita 323* (BM); Palermo, May, *M. Lojacono s.n.* (M); Capaci, June 1896, *Mandralisca s.n.* (PAL).

7. Genista insularis Bacch., Brullo & Feoli Chiapella, sp. nov. TYPE: [Italy. Sardinia:] Sardegna, Domus de Maria (CA), 7 June 2002, *G. Bacchetta, S. Brullo & G. Giusso s.n.* (holotype, CAT; isotypes, CAG, CAT, FI). Figures $1A_5$, B_5, $3A_3$, B_3.

Haec species a *Genista valsecchiae* Brullo & De Marco ramis flexuosis acutis inermibus, bractea lineari vel oblongo-lineari 3.5–6.5 mm longa, bracteolis lanceolatis vel triangulari-lanceolatis, calycis labio inferiore 2–2.2 mm longo, vexillo ad apicem leviter retuso 5–7 mm lato, carina 8–10 mm longa atque antheris oblongo-lanceolatis 1–1.3 mm longis differt.

Erect shrub, robust, lax, 100–150 cm tall, with branches flexuous, alternate or subclustered, acute at the apex, striate, pubescent. Leaves 3-foliate, uppermost often simple, sessile, linear-lanceolate, revolute, sericeous, 3–7 mm, caducous. Inflorescence ± dense, 3–7 cm, 4- to 9-flowered; bracts linear, 3.5–4 mm, much longer than the pedicel; bracteoles triangular-lanceolate, 1.3–1.5 mm, inserted at calyx base. Calyx sericeous, conic, 3.5–4 mm, with veins incrassate and decurrent only in the lip, lower lip longer than the upper, 2–2.2 × 1.3–1.6 mm, with teeth unequal, triangular, slightly divaricate, lateral ones 0.4–0.5 mm, central one 0.6–0.7 mm, upper lip with teeth 1-nerved, ovate-triangular, apiculate, 1.5–1.8 mm; floral buds with wings covered by the standard; corolla yellow; standard ovate-cordate, retuse at the apex, 6.5–7 × 5–5.6 mm, sericeous on the back; wings 6.5–7 mm, with a tuft of hairs on the basal gibbosity; keel 8–8.5 mm, sericeous on outer faces; anthers oblong-lanceolate, apiculate, 1.2–1.3 mm. Legume totally pubescent, ovate-beaked, ca. 8 mm.

Chromosome number. $2n = 48 + (0–2B)$ (Domus de Maria, S'Isca Manna [Cagliari], 2 June 2000, *G. Bacchetta, G. Sotgiu Cocco & M. Casti s.n.* [CAG], new count).

Distribution and ecology. The new species is circumscribed to the southwestern part of the Sulcis massif in southern Sardinia (Punta Is Laghixeddas, Riu s'Accorradroxiu, S'Isca Manna–Domus de Maria). *Genista insularis* grows on granite and metamorphic substrates at altitudes from 80 to 360 m, where it is frequent in garigue vegetation occurring in oak wood clearings. The bioclimate is Mediterranean pluviseasonal-oceanic, with thermotype ranging between upper thermomediterranean and lower mesomediterranean, and ombrotype between upper dry and lower subhumid (Bacchetta, 2006).

IUCN Red List category. *Genista insularis* is assessed here as Least Concern (LC) according to IUCN Red List criteria (IUCN, 2001, 2003).

Etymology. The specific epithet is from the Latin "insula," meaning "island."

Paratypes. ITALY. **Sardinia:** Domus de Maria, 13 June 1971, *N. Kaae s.n.* (C); Domus de Maria, M.ti Sa Guardia, 18 Apr. 1998, *G. Bacchetta s.n.* (CAG, TSB), 9 June 1998, *G. Bacchetta & S. Brullo s.n.* (CAT); S'Isca Manna, Domus de Maria (CA), 9 June 1998, *G. Bacchetta & S. Brullo s.n.* (CAT); Domus de Maria, SS. 195, 4 km direzione Teulada (Cagliari), 1 July 1998, *G. Bacchetta s.n.* (CAG); Domus de Maria, S'Isca Manna (Cagliari), 2 June 2000, *G. Bacchetta, G. Sotgiu Cocco & M. Casti s.n.* (CAG); Riu s'Accorradroxiu-Domus de Maria (Cagliari), 25 Mar. 2004, *G. Bacchetta & C. Pontecorvo s.n.* (CAG, TSB).

7a. Genista insularis subsp. **insularis**.

7b. Genista insularis subsp. **fodinae** Bacch., Brullo & Feoli Chiapella, subsp. nov. TYPE: [Italy. Sardinia:] Sardegna, Monte Conca s'Omu, Fluminimaggiore (CA), 6 June 2002, *G. Bacchetta, S. Brullo, M. Casti & G. Giusso s.n.* (holotype, CAT; isotypes, CAG, CAT, FI). Figures $1A_3$, B_3, $3A_4$, B_4.

A *Genista insulari* Bacch., Brullo & Feoli Chiapella subsp. *insulari* bractea oblongo-lineari 5 6.5 mm longa, bracteolis lanceolatis, calyce 4 4.5 mm longo dentibus labii inferioris erectis 0.7 0.8 mm longis, vexillo 8 9 mm longo 6–7 mm lato, alis 7.5–8.5 mm longis, carina 9–10 mm longa atque antheris ca. 1 mm longis differt.

Erect shrub, robust, lax, 100–200 cm tall, with branches flexuous, alternate or subclustered, acute at the apex, striate, pubescent. Leaves 3-foliate, uppermost often simple, sessile, linear-lanceolate, revolute, sericeous, 3–7 mm, caducous. Inflorescence ± dense, 2–4 cm, 4- to 8-flowered; bracts oblong-linear, 5–6.5 mm, slightly longer than the pedicel; bracteoles lanceolate, 1.2–1.5 mm, inserted at calyx base. Calyx sericeous, conic-campanulate, 4–4.5 mm, with veins incrassate and decurrent only in the lip, lower lip longer than the upper, 2–2.2 × 1.5–2 mm, with teeth subequal, triangular-subulate, erect, 0.7–0.8 mm, upper lip with teeth 1-nerved, ovate-triangular, apiculate, 1.2–1.5 mm; floral buds with wings covered by the standard; corolla yellow; standard ovate-cordate, retuse at the apex, 8–9 × 6–7 mm, sericeous on the back; wings 7.5–8.5 mm, with a tuft of hairs on the basal gibbosity; keel 9–10 mm, sericeous on the outer faces; anthers oblong-lanceolate, apiculate, ca. 1 mm. Legume totally pubescent, ovate-beaked, ca. 8 mm.

Chromosome number. $2n = 48$ (Su Zurfuru-Fluminimaggiore [Cagliari], 210 m, 10 July 2002, *G. Bacchetta & C. Pontecorvo s.n.* [CAG], new count).

Distribution and ecology. *Genista insularis* subsp. *fodinae* is endemic to the Iglesiente subsector in southwestern Sardinia, Italy, and in particular occurs in the mining areas of Monte Conca's Omu and Su Zurfuru, near Fluminimaggiore. The new subspecies grows on metalliferous metamorphic substrates at altitudes from 120 to 215 m, where it colonizes the rocky places and loose substrates within pioneer plant communities. The bioclimate is Mediterranean pluviseasonal-oceanic, with thermotype ranging between upper thermomediterranean and lower mesomediterranean, and ombrotype between lower and upper subhumid (Bacchetta, 2006).

IUCN Red List category. *Genista insularis* subsp. *fodinae* is assessed here as Near Threatened (NT) according to IUCN Red List criteria (IUCN, 2001, 2003).

Etymology. The subspecific epithet refers to the Latin "fodina," meaning "mine," because the new taxon grows in the mining areas of Iglesiente, in southwestern Sardinia.

Note. Two subspecies are recognized within *Genista insularis*. They are quite different from both the morphological and eco-chorological viewpoint. These taxa share the same habit with flexuous and loose branches that are acute and not mucronate-pungent at apex; inflorescences with up to eight to 10 flowers; and a calyx with incrassate veins, retuse standard, and wings that are covered by the standard in the bud. *Genista insularis* subsp. *fodinae* differs from the autonymic subspecies in having oblong-linear bracts 5–6.5 mm long (vs. linear bracts 3.5–4

mm long in subspecies *insularis*), lanceolate bracteoles (vs. triangular-lanceolate), the calyx 4–4.5 mm long with lower lip teeth 0.7–0.8 mm long (vs. 3.5–4 mm long with lower lip teeth 0.4–0.7 mm long), the standard 8–9 × 6–7 mm (vs. 6.5–7 × 5.5–6 mm), wings 7.5–8.5 mm long (vs. 6.5–7 mm long), the keel 9–10 mm long (vs. 8–8.5 long), and anthers ca. 1 mm long (vs. 1.2–1.3 mm long). In addition to these morphological differences, there are some relevant ecological and chorogical differences. *Genista insularis* subsp. *insularis* occurs in a small area of southern Sardinia (near Cagliari), where it grows on granitic and compact metamorphic substrates, while the subspecies *fodinae*, which is also extremely circumscribed, has a northernmost localization (near Iglesias), where it is found on metalliferous loose substrates.

Paratypes. ITALY. **Sardinia:** Iglesias, 30 Apr. 1983, *G. De Marco s.n.* (CAT); Fluminimaggiore CA, 1 May 1995, *S. Brullo & G. De Marco s.n.* (CAT); Fluminimaggiore, Miniera de Su Zurfuru (Cagliari), 10 July 2002, *G. Bacchetta, G. Garau, L. Piras & C. Pontecorvo s.n.* (CAG); Su Zurfuru-Fluminimaggiore (Cagliari), 215 m, 25 Mar. 2004, *G. Bacchetta & C. Pontecorvo s.n.* (CAG, TSB).

8. Genista numidica Spach, Ann. Sci. Nat., Bot., ser. 3, 2: 244. 1844. Replaced synonym: *Spartium sphaerocarpum* Desf. ex Spach, Ann. Sci. Nat., Bot., ser. 3, 2: 244. 1844, pro syn., nom. inval. non *Spartium sphaerocarpum* L., Mant. Pl. Altera: 571. 1771. TYPE: [Algeria.] Numidia, s.d., *R. L. Desfontaines s.n.* (lectotype, designated here, FI-W, sub *Spartium sphaerocarpum*).

Erect shrub to arborescent, robust, 60–250 cm tall, with branches lax, flexuous, alternate or subclustered, acute at the apex, striate, glabrescent. Leaves 3-foliate, uppermost often simple, sessile, linear-lanceolate, revolute, sericeous, 5–13 mm, caducous. Inflorescence ± dense, 1.5–10 cm, 5- to 30-flowered; bracts linear to linear-lanceolate, 3.5–4 mm, much longer than pedicel; bracteoles linear, 2–2.5 mm, inserted at calyx base. Calyx sericeous, conic-campanulate, 3–5 mm, with veins thin and extended almost to base, lower lip longer than upper, 2.5–3 × 0.5–1 mm, with teeth unequal, triangular to sublinear, slightly divaricate, lateral ones 0.5–0.6 mm, central one 0.8–1 mm, upper lip with teeth 1-nerved, triangular, acute, 2–2.5 mm; floral buds with wings wholly covered by standard; corolla yellow; standard ovate-cordate, retuse at apex, 8–9 × ca. 5 mm, sericeous on back; wings 6–8 mm, with a tuft of hairs on basal gibbosity; keel 9–11 mm, sericeous on outer faces; anthers oblong, aristate, 0.5–0.75 mm. Legume totally pubescent, ovoid-beaked, 5.5–6 mm.

Iconography. Maire (1987, fig. 54).

Chromosome number. Unknown.

Distribution and ecology. Genista numidica is circumscribed to Algeria, where it grows in garigue and maquis ecosystems at altitudes between 0 and 1100 m. The bioclimate is Mediterranean pluviseasonal-oceanic, with thermotype ranging between upper thermomediterranean and upper mesomediterranean, and ombrotype between upper dry and upper subhumid (Rivas-Martínez, 2007).

IUCN Red List category. Genista numidica is assessed here as Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001, 2003).

Note. In the protologue of *Genista numidica*, Spach (1844) indicated as synonym *Spartium sphaerocarpum* Desf. (in Herb. Flor. Atlant. quod flores solum[!], in sched.). This unpublished name, written by Desfontaines on the label of a specimen coming from his own *Flora Atlantica* collection, is a nomen nudum. This name is unavailable for use because it is a later homonym of *S. sphaerocarpum* L. Therefore, this name being illegitimate, Spach (1844) proposed a different epithet (*numidica*) for this species. However, Spach failed to designate a type for the species. For this reason, a type needs to be assigned for *G. numidica* from among the Desfontaines specimens that he identified as *S. sphaerocarpum*. There is a Desfontaines specimen at FI-W of *Flora Atlantica* labeled "*Spartium sphaerocarpum*, Numidia," which is here designated as lectotype.

Additional specimens examined. ALGERIA. Saffsaf, Philippeville, 11 May 1853, *R. Gallerand s.n.* (B); entre Stora et Philippeville, 3 June 1858, *S. Choulette s.n.* (B, P); Kabylie, Tifrit, 30 May 1866, *A. Letourneux s.n.* (P); Caroubiers, Bône, 22 Apr. 1866, *Tribout s.n.* (B), May 1875, *A. Meyer s.n.* (P), May 1841, *M. C. Durieu de Maisonneuve s.n.* (LG); Coteaux du Fort Genois, Bône, 21 May 1892, *D. Luizet s.n.* (B); Bône, entre la Ville et le Cap de Garde, 10 May 1906, *H. Romieux s.n.* (B); Djidjelli, 23 Apr. 1938, *G. Andreánszky s.n.* (B); Dept. d'Alger, Tamgout d'Azazga, 6 June 1952, *L. Faurel s.n.* (LG); Dépt. d'Orléansville, entre Aïn N'Sour et Tizi Franco, 17 May 1964, *A. Dubuis et L. Faurel s.n.* (LG); Annaba, Wilaya Annaba, 7 July 1979, *A. Dubuis* [Soc. l'éch. Pl. vasc. l'Europe Bass. Méd.] *17084* (LG); Wilaya de Jijel, entre Jijel & Ziama-Mansouria, 9 June 1984, *A. Dubuis s.n.* (LG); Parc Natl. l'Akfadan, Yakourren, 27 May 1984, *A. Bologna s.n.* (CAT); Wilaya Jijel, 16 June 1984, *D. Podlech s.n.* (LG); Parc Natl. d'Akfadou, Wilaya Tizi-Ouzou, 40 km à l'E de Tizi-Ouzou, 25 May 1989, *A. Dubuis* [Soc. l'éch. Pl. vasc. l'Europe Bass. Méd.] *17085* (LG).

9. Genista ovina Bacch., Brullo & Feoli Chiapella, sp. nov. TYPE: [Italy. Sardinia:] Capo Pecora, Portixeddu–Fluminimaggiore, metamorfiti pale-

ozoiche, 80 m, 9 Mar. 2004, *G. Bacchetta, M. Casti, A. De Murtas, C. Pontecorvo & J. Cano s.n.* (holotype, CAT; isotypes, CAG, CAT, FI). Figures $1A_6$, B_6, $3A_5$, B_5.

Haec species a *Genista valsecchiae* Brullo & De Marco habitu pulvinato, planta usque ad 60 cm tantum alta, bractea 3.5 4.5 mm longa, bracteolis ovato-triangularibus, calycis labio inferiori 3 3.5 mm longo dentibus 0.9 1.2 mm longis, vexillo ad apicem rotundato 7 7.5 mm longo 5 6 mm lato, alis 7 8 mm longis, carina 7.5 9 mm longa, alis in alabastro e vexillo exsertis atque antheris ellipticis rotundatis 1.1 1.2 mm longis differt.

Pulvinate, robust, intricate, 30–60 cm tall, with branches rigid, alternate or subclustered, acute at the apex, striate, pubescent. Leaves 3-foliate, uppermost often simple, sessile, linear-lanceolate, revolute, sericeous, 3–7 mm, caducous. Inflorescence ± dense, 1–4.5 cm, 5- to 12-flowered; bracts oblong-linear, 3.5–4.5 mm, much longer than the pedicel; bracteoles ovate-triangular, 0.8–1.5 mm, inserted at calyx base. Calyx sericeous, conic-campanulate, 3.5–5 mm, with veins thin and decurrent only on the lip, lower lip longer than the upper, 3–3.5 × 1.5–1.7 mm, with teeth subequal, linear-subulate, divaricate, 0.9–1.2 mm, upper lip with teeth 1-nerved, ovate-triangular, acute, 1.7–2.2 mm; floral buds with wings exserted from the standard; corolla yellow; standard ovate-cordate, rounded at the apex, 7–7.5 × 5–6 mm, sericeous externally; wings 7–8 mm, with a tuft of hairs on basal gibbosity; keel 7.5–9 mm, sericeous on outer faces; anthers elliptical, rounded at apex, 1.1–1.2 mm. Legume totally pubescent, ovate-beaked, ca. 8 mm.

Chromosome number. $2n = 44$, 48 (Capo Pecora, Portixeddu, Fluminimaggiore [CA], 9 June 2004, *G. Bacchetta, U. Gamper & C. Pontecorvo s.n.* [TSB], new count).

Distribution and ecology. *Genista ovina* is a very localized species, known only from Capo Pecora and Portixeddu, near Fluminimaggiore in southwestern Sardinia, where it grows on metamorphic substrates at altitudes between 40 and 100 m. The new species is dominant in thermophilous garigue vegetation occurring along the rocky coast. The bioclimate is Mediterranean pluviseasonal-oceanic, with thermotype upper thermomediterranean and ombrotype upper dry (Bacchetta, 2006).

IUCN Red List category. *Genista ovina* is assessed here as Near Threatened (NT) according to IUCN Red List criteria (IUCN, 2001, 2003).

Etymology. The specific epithet is from the Latin "ovinus," meaning "sheep." In Italian, the word "pecora" also refers to sheep, and the plants grow on Capo Pecora, in Arbus municipality, southwestern Sardinia.

Paratypes. ITALY. **Sardinia:** Portixeddu (Cagliari), 23 June 1973, *E. & S. Pignatti, A. Avanzini & P. Nimis s.n.* (TSB); Portixeddu, Rupi marittime (Cagliari), 23 June 1973, *E. & S. Pignatti, A. Avanzini & P. Nimis s.n.* (TSB); Capo Pecora, rupi litorali e nell'interno, 6 Apr. 1977, *Milia & L. Mossa s.n.* (CAG); Strasse zum Capo Pecora, ca. 2 km NW von Portixeddu, 2 May 1986, *J. Poelt s.n.* (M); Capo Pecora, Portixeddu, Fluminimaggiore (CAG), 11 June 1998, *G. Bacchetta & S. Brullo s.n.* (CAT), 9 Feb. 2004, *G. Bacchetta, J. Cano, M. Casti, A. De Murtas, C. Pontecorvo s.n.* (TSB); Fluminimaggiore, Portixeddu, Capo Pecora (Cagliari), 80 m, 9 June 2004, *G. Bacchetta, U. Gamper & C. Pontecorvo s.n.* (CAG, TSB).

10. Genista tyrrhena Vals., Boll. Soc. Sarda Sci. Nat. 25: 145. 1986, as "*thyrrena*" [corr. ICBN, Art. 60.1]. TYPE: [Italy. Sicily:] "in sylvaticis Vulcano (Eolie)," Apr. 1902, *G. Zodda s.n.* (holotype, FI). Figures $2A_1$, B_1, $3A_7$, B_7.

Erect shrub to arborescent, robust, 100–400 cm tall, with branches flexuous, alternate or subclustered, truncate or obtuse at the apex, striate, sericeous or sericeous-pubescent. Leaves 3-foliate, uppermost often simple, sessile, linear-lanceolate, revolute, sericeous, 7–12 mm, caducous. Inflorescence ± dense, 3–15 cm, 10- to 30-flowered; bracts linear-subulate to ovate-lanceolate, 1.5–5 mm, much longer than the pedicel; bracteoles lanceolate, 2–4.5 mm, inserted at the calyx base. Calyx sericeous, conic-campanulate, 4–7 mm, with veins incrassate and extended almost up to the base, lower lip longer than the upper, 2.5–4 × ca. 2 mm, with teeth unequal, subulate, not divaricate, lateral ones 1–2 mm, central one 0.8–1.2 mm, upper lip with teeth 1-nerved, ovate-triangular, long acuminate, 2.1–3.5 mm; floral buds with wings wholly covered by the standard; corolla yellow; standard ovate-subcircular, rounded at the apex, 8–12 × ca. 8 mm, sericeous on the back; wings 8–10 mm, with a tuft of hairs on the basal gibbosity; keel 9–11 mm, sericeous on the outer faces; anthers oblong-lanceolate, apiculate, 1.2–1.4 mm. Legume totally pubescent, ovate-beaked, 8–10 mm.

Iconography. Valsecchi (1986b, fig. 2); Brullo et al. (1993, figs. 3, 4A3, 4B3).

Chromosome number. $2n = 48$ (Lipari, Capistello, Isole Eolie [Messina], 6 July 2002, *S. Pasta s.n.* [TSB], new count).

Distribution and ecology. The autonymic subspecies is present on Vulcano, Lipari, Salina, Panarea, and Stromboli (Aeolian Islands, Italy). It grows on

volcanic substrates, in thermophilous garigue vegetation at altitudes of 0–800 m. The bioclimate is Mediterranean pluviseasonal-oceanic, with thermotype ranging between upper thermomediterranean and lower mesomediterranean, and ombrotype between upper dry and lower subhumid (Brullo et al., 1996).

IUCN Red List category. *Genista tyrrhena* is assessed here as Least Concern (LC) according to IUCN Red List criteria (IUCN, 2001, 2003).

Additional specimens examined. ITALY. **Sicily:** In insulis Aeoliis, s.d., s. coll. (BM); Vulcano al piano Casa Sperlazzi, 8 May 1844, s. coll. (PAL); Lipari, Oct. 1858, *Mandralisca s.n.* (FI), 29 May 1933, *J. F. N. Bormüller 514* (C); Isole Eolie in tutte le isole, May 1877, *M. Lojacono s.n.* (WU); Lipari, June 1881, *A. Borzì s.n.* (WU); Vulcano (Eolie), Apr. 1902, *G. Zodda s.n.* (FI), July 1902, *L. Nicotra s.n.* (FI), June 1881, *A. Borzì s.n.* (FI), 22 Apr. 1962, *C. M. Christensen s.n.* (C); Stromboli, 8 Apr. 1913, *F. K. M. Vieerhapper s.n.* (WU); Vulcano Italian, 22 Apr. 1962, *K. Larsen s.n.* (C); Lipari Acqua Calda, 20 May 1969, *S. Brullo s.n.* (CAT); Vulcano, Isole Eolie (Messina), 22 May 1969, *D. Lausi s.n.* (TSB), June 1969, *S. Pignatti s.n.* (TSB); Stromboli, Isole Eolie (Messina), 25 May 1969, *D. Lausi s.n.* (TSB); Lipari, Marina Piccola, Isole Eolie (Messina), 1 June 1969, *S. Pignatti s.n.* (TSB); Salina, 14 May 1970, *S. Brullo s.n.* (CAT); Cava di Pomice, Lipari, 13 May 1972, *S. Brullo s.n.* (CAT); Porticello, Lipari, 25 Apr. 1982, *S. Brullo s.n.* (CAT); Tra Canneto e Porticello, Lipari, 17 June 1992, *Minissale s.n.* (CAT); Panarea, 28 Apr. 1982, *S. Brullo s.n.* (CAT); Stromboli sopra Fico Grande, 8 May 1990, *S. Brullo, P. Minissale, F. Scelsi & G. Spampinato s.n.* (CAT); Lipari, Capistello, Isole Eolie (Messina), 6 July 2002, *S. Pasta s.n.* (TSB).

10a. Genista tyrrhena subsp. **tyrrhena**.

10b. Genista tyrrhena subsp. **pontiana** Brullo & De Marco, subsp. nov. TYPE: [Italy.] Lazio: Isola di Ponza, 16 May 1993, *S. Brullo, F. Scelsi & G. Siracusa s.n.* (holotype, CAT; isotypes, CAG, CAT, FI). Figures $2A_4$, B_4, $3A_{11}$, B_{11}.

A *Genista tyrrhena* Vals. subsp. *tyrrhena* bractea lineari-triangulari vel lineari-subulata 3 13 mm longa, bracteolis lanceolato-subulatis vel subulatis 1.8 2 mm longis, calyce 3.5 5.5 mm longo labio inferiore 2 2.7 mm longo 1.4 1.8 mm lato dentibus 0.7 1 mm longis atque alis in alabastro e vexillo exsertis differt.

Erect shrub to arborescent, robust, 100–250 cm tall, with branches flexuous, lax, alternate or subclustered, truncate or obtuse at the apex, striate, sericeous. Leaves 3-foliate, uppermost often simple, sessile, linear-lanceolate, revolute, sericeous, 7–12 mm, caducous. Inflorescence ± dense, 5–12 cm, 10- to 30-flowered; bracts linear-triangular to linear-subulate, 3–13 mm, much longer than pedicel; bracteoles lanceolate-subulate to subulate, 1.8–2 mm, inserted at calyx base. Calyx sericeous, conic-campanulate, 3.5–5.5 mm, with veins thin and slightly extended toward base, lower lip longer than upper, 2–2.7 × 1.4–1.8 mm, with teeth unequal, linear-subulate, not divaricate, lateral ones 0.9–1 mm, central one 0.7–0.8 mm, upper lip with teeth 1-nerved, ovate-triangular, apiculate, 2–2.7 mm; floral buds with wings exserted from the standard; corolla yellow; standard ovate-subcircular, rounded at the apex, 9–11 × 7–8 mm, sericeous on back; wings 8–9 mm, with a tuft of hairs on basal gibbosity; keel 8–10 mm, sericeous on outer faces; anthers oblong-lanceolate, apiculate, 1.2–1.4 mm. Legume totally pubescent, ovate-beaked, 10–11 mm.

Chromosome number. $2n = 48 + (0–2B, 72, 96)$ (Zannone, M. Pellegrino, Isole Ponziane [Latina], 6 May 2000, *P. Mayer s.n.* [TSB], new count).

Distribution and ecology. *Genista tyrrhena* subsp. *pontiana* is circumscribed to the Pontine Islands off the coast of west-central Italy and grows on volcanic substrates, in thermophilous garigue vegetation at altitudes of 0–280 m. The bioclimate is Mediterranean pluviseasonal-oceanic, with thermotype ranging between upper thermomediterranean and lower mesomediterranean, and ombrotype between upper dry and lower subhumid (Rivas-Martínez, 2007).

IUCN Red List category. *Genista tyrrhena* subsp. *pontiana* is assessed here as Least Concern (LC) according to IUCN Red List criteria (IUCN, 2001, 2003).

Etymology. The specific epithet refers to the Pontine Archipelago.

Paratypes. ITALY. **Latium:** Ponza, sulle rupi marittime presso il semaforo, 27 Apr. 1900, *A. Beguinot* (FI); Zannone, M. Pellegrino nel bosco, May 1950–June 1951, *B. Anzalone s.n.* (RO); Palmarola, 11 Apr. 1966, *B. Anzalone s.n.* (RO); Isola di Ponza, 16 May 1993, *S. Brullo, F. Scelsi & G. Siracusa s.n.* (CAT); Isola di Ponza [Arcipelago Ponziano], Mt. Guardia, 9 Apr. 1969, *B. Anzalone s.n.* (RO), 10 May 1982, *G. De Marco s.n.* (CAT); Piana d'Incenso, 9 Apr. 1969, *B. Anzalone s.n.* (RO); Li Conti, 9 Apr. 1969, *B. Anzalone s.n.* (RO); Isola di Gavi, 18 Apr. 1971, *L. Veri s.n.* (RO); Isola di Ponza, tra Ponza e il M. Pagliaro, 20 May 1987, *M. G. Mariotti s.n.* (FI); Zannone, M. Pellegrino, Isole Ponziane (Latina), 6 May 2000, *P. Mayer s.n.* (TSB).

11. Genista valsecchiae Brullo & De Marco, Pl. Syst. Evol. 200: 275. 1996. TYPE: [Italy.] Sardinia: Isola di San Pietro, contr. Giacchino, 11 May 1994, *S. Brullo, G. De Marco & P. Pavone s.n.* (holotype, CAT). Figures $1A_2$, B_2, $3A_2$, B_2.

Erect shrub, robust, intricate, 30–150 cm tall, with branches rigid, alternate or subclustered, mucronate, pungent at the apex, striate, pubescent. Leaves 3-foliate, uppermost often simple, sessile, linear-lanceolate, revolute, sericeous, 3–10 mm, caducous. Inflorescence ± dense, 2.5–6 cm, 5- to 11-flowered; bracts linear-lanceolate, 1–3.5 mm, longer than the pedicel; bracteoles linear-lanceolate, 0.5–1.5 mm, inserted at the calyx base. Calyx sericeous, conic-campanulate, 3.5–5 mm, with veins thin and extended almost up to the base, lower lip longer than the upper, 2.5–3 × ca. 1.5 mm, with teeth equal, lanceolate-subulate, slightly divaricate, 0.5–0.8 mm, upper lip with teeth 2-nerved, ovate-triangular, long apiculate, 1.5–2.2 mm; floral buds with wings covered by the standard; corolla yellow; standard cordate, obtuse at the apex, 6–6.5 × ca. 7 mm, sericeous on the back; wings 6–7 mm, with a tuft of hairs on the basal gibbosity; keel 9–10 mm, sericeous on the outer faces; anthers ovate-lanceolate, apiculate, 0.9–1 mm. Legume totally pubescent, ovate-beaked, ca. 8 mm.

Iconography. Brullo and De Marco (1996, fig. 1).

Chromosome number. $2n = 48$ (Sant'Antioco [Cagliari], 27 Apr. 1984, *L. Rizzi Longo s.n.* [TSB], new count).

Distribution and ecology. *Genista valsecchiae* is widespread in southwestern Sardinia between Capo Frasca and Pula, including the islands of San Pietro and Sant'Antioco. It grows on granite, metamorphic, and volcanic substrates at altitudes of 0–100 m, where it is a structural species of thermophilous garigue ecosystems, near the coast. The bioclimate is Mediterranean pluviseasonal-oceanic or xeric-oceanic, with thermotype upper thermomediterranean and ombrotype upper dry.

IUCN Red List category. *Genista valsecchiae* is assessed here as Near Threatened (NT) according to IUCN Red List criteria (IUCN, 2001, 2003).

Additional specimens examined. ITALY. **Sardinia:** Figola by Antioco, s.d., s. coll. (OXF); St. Antioco, May, *F. Müller s.n.* (M); Antioco, Sardinia, 1828, *F. Müller s.n.* (OXF); Pula, May 1829, *J. H. Moris s.n.* (TO); Capo Spartivento nei colli fra il Golfo Malfitano e Domus de Maria, 21 Apr. 1893, *U. Martelli s.n.* (FI); Cagliari, Porto S. Efisio, Pula, 14 Apr. 1894, *U. Martelli s.n.* (FI); Isola di S. Antioco, M. Perdas de Fogu, 26 Apr. 1894, *U. Martelli s.n.* (FI); Portovesme, 6 Apr. 1896, *U. Martelli s.n.* (FI); Isola di S. Antioco, macchie under Strasse 3 km südöstlich Calasetta, 9 20 Apr. 1966, *H. Merxmüller & F. Oberwinkler 21037* (M); Carloforte, Isola di S. Pietro, 30 July 1970, *L. Mossa & G. Mura s.n.* (CAG); Sard. Antioco Island, 4 km S of Antioco town, 12 Apr. 1973, *C. J. Humphries & I. Richardson 227* (C); Isola di S. Antioco, 3 Mar. 1975, *Milia & L. Mossa s.n.* (CAG); Isola di S. Antioco, 20 Apr. 1975, *I. Camarda s.n.* (CAG); Pula, Agumu, 25 Mar. 1982, *E. Bocchieri & G. Zedda s.n.* (CAG); S. Pietro, 23 Apr. 1983, *G. De Marco s.n.* (CAT); Domus de Maria, Isola su Cardulinu, 11 Nov. 1983, *E. Bocchieri 3675050* (CAG); S. Antioco (Cagliari), 27 Apr. 1984, *L. Rizzi Longo s.n.* (TSB); Carloforte, Isola di S. Pietro, la Caletta, 1 May 1984, *L. Mossa s.n.* (CAG); Portoscuso, 11 May 1994, *S. Brullo, G. De Marco & P. Pavone s.n.* (CAT); Spalmatore, Isola di San Pietro, 12 May 1994, *S. Brullo, G. De Marco & P. Pavone* (CAT); Pula, Agumu, 13 Apr. 1997, *G. Bacchetta s.n.* (CAG); Chia-Domus de Maria (Cagliari), 21 Apr. 1997, *C. Giusto s.n.* (TSB).

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Transfer of *Anoectochilus tetrapterus* to *Odontochilus* (Orchidaceae)

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ABSTRACT. *Anoectochilus tetrapterus* Hook. f. (Orchidaceae) is transferred to *Odontochilus* Blume as *O. tetrapterus* (Hook. f.) Av. Bhattacharjee & H. J. Chowdhery based on its morphological characteristics. An emended description and illustration are provided to facilitate identification of the species.

Key words: *Anoectochilus*, *Odontochilus*, Orchidaceae.

Odontochilus Blume (Orchidaceae) is often included in *Anoectochilus* Blume because of its flowers with a similar lip and column structure. Blume (1858–1859), Bentham (1883), Hooker (1890), and Pridgeon et al. (2003) treated the genera separately, whereas Lindley (1840), King and Pantling (1898), Pradhan (1976), Seidenfaden (1978), and Govaerts et al. (2010) treated the species of *Odontochilus* under *Anoectochilus*. Mabberley (2008) mentioned the occurrence of about 30 species of *Anoectochilus* and 45 species of *Odontochilus* (including *Chamaegastrodia* Makino & F. Maek.) in the world. In India, *Anoectochilus* is represented by five species, whereas seven species of *Odontochilus* have been recorded from India during the present work. Pridgeon et al. (2003) recognized these two genera separately as classified within the subtribe Goodyerinae Klotzsch, tribe Cranichideae Endl. of the subfamily Orchidoideae Lindl.

J. D. Hooker (1890) described *Anoectochilus tetrapterus* Hook. f. based on C. B. Clarke's collection from Manipur, India. Later, while treating the species, Hooker (1894: t. 2160) mentioned that "from the shortness of its spur this species of *Anoectochilus* approximates nearest of all to *Odontochilus*, and tends to invalidate the very artificial character by which these genera are kept apart—namely, that in the former genus the spur, even if reduced to a sac, is exposed, whereas in *Odontochilus* the sac is concealed by the bases of the lateral sepals, which hence form a mentum." However, during revisionary studies of the subtribe Goodyerinae Klotzsch for the Flora of India project through the Botanical Survey of India, critical studies on both genera as found in India strongly suggest that they are quite distinct and should be recognized as separate.

Anoectochilus tetrapterus can be identified by the presence of a 4-lobed, cruciform epichile and the floral column with two irregular membranous appendages at the base. The taxon has green leaves with yellowish white veins (vs. reticulate in *Anoectochilus*); the hypochile is deeply saccate or shortly spurred (vs. long-spurred in *Anoectochilus*) and has elongate-oblong appendages (vs. irregularly peltate to caruunculate appendages); and the column has anterior stigma lobes (vs. lateral in *Anoectochilus*). The mesochile of *A. tetrapterus* is also very similar to a species of *Odontochilus* (*O. crispus* (Lindl.) Hook. f.) in being entire. Thus, *A. tetrapterus* is transferred to *Odontochilus* in the present treatment. It is worth mentioning that the illustration (t. 2160) of "*Anoectochilus tetrapterus*" in *Icones Plantarum* (1894) was inaccurately portrayed. Furthermore, the apical portion of the inflorescence (with two flowers) was later removed from the holotype (*C. B. Clarke 42191*), most likely so the flowers could be studied.

Odontochilus tetrapterus (Hook. f.) Av. Bhattacharjee & H. J. Chowdhery, comb. nov. Basionym: *Anoectochilus tetrapterus* Hook. f., Fl. Brit. India [J. D. Hooker] 6: 96. 1890. TYPE: India. Muneypoor [Manipur], Eerung, 2000 ft., 27 Nov. 1885, *C. B. Clarke 42191* (holotype, K not seen, K photo). Figure 1.

Terrestrial herb, 9–20 cm tall, rhizomatous; rhizome 4–6 cm, 2–3 mm diam., creeping, terete, rooting at nodes; roots 0.5–2 cm, pale yellowish brown, fleshy; stems 2–3 × 0.2–0.3 cm, ascending, glabrous, leafy. Leaves 3 or 4, 2.5–5.5 cm, scattered, glabrous, petiolate; petiole 0.4–1 cm, sheathing at base; lamina 1.9–4.5 × 1.2–2.4 cm, obliquely ovate, dark velvety green, with 5 yellowish white veins, base obtuse to subtruncate, apex acute to acuminate. Inflorescence racemose, terminal, laxly 3- or 4-flowered, pubescent; peduncles 5–6 cm, with 2 sheathing bracts of 1.3–1.6 cm, lanceolate, long-acuminate, scarious, pubescent; rachis 2.5–5 cm. Floral bracts 1–1.4 × 0.25–0.4 cm, equal to or longer than ovary, lanceolate, acuminate, pubescent; flowers 1.7–2 cm; sepals free, pubescent outside, ciliate at apex, 1-veined; dorsal sepal 5–8 ×

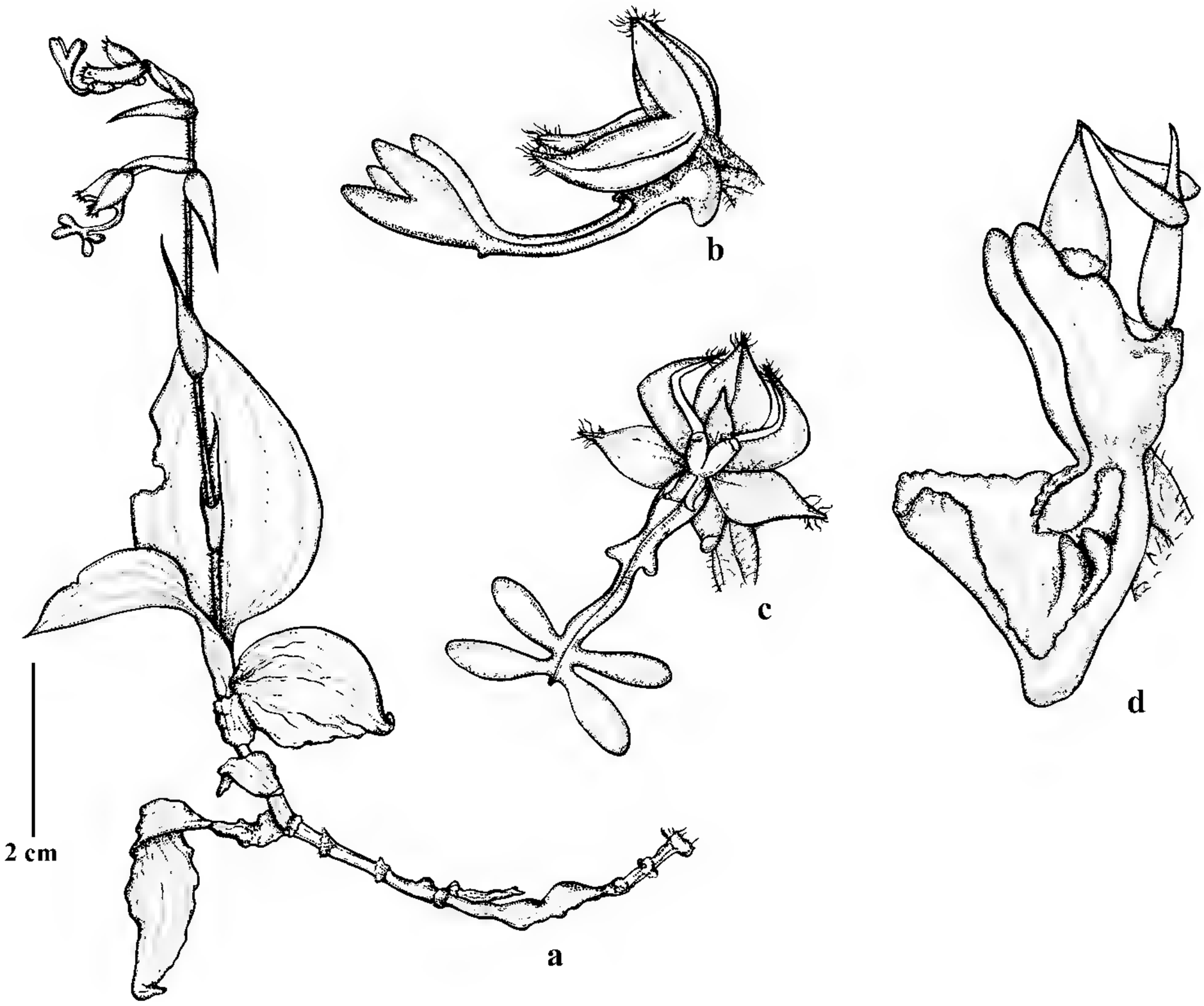

Figure 1. *Odontochilus tetrapterus* (Hook. f.) Av. Bhattacharjee & H. J. Chowdhery. —A. Fertile plant. —B. Part of flower (lateral view). —C. Part of flower showing cruciform epichile. —D. Column. A drawn from the holotype, *C. B. Clarke 42191* (K); B–D adapted from Hooker (1894).

3–4.5 mm, ovate, concave, forming a hood with petals, acuminate; lateral sepals 6–9 × 3–4 mm, ovate, spreading, acute; petals 5–8 × 3–4 mm, obliquely lanceolate, appressed to dorsal sepal, pubescent outside, ciliate at apex, 1-veined, subacute; labellum 1.2–1.7 cm, white; hypochile deeply saccate or shortly spurred, 1.5–2 × 1–1.5 mm, subconical, with 1 elongate-oblong appendage inside on each side, appendages entire, obtuse at apex; mesochile 5–7 × 1.9–2.2 mm, channeled, margin entire, without any fringe; epichile 4-lobed, cruciform, minutely apiculate at junction of 2 apical lobes, lobes 2–3.5 × 1.3–2 mm, oblong, divaricate, margin entire, obtuse at apex; column 2–2.5 mm, with 2 fleshy wings in front and 2 irregular membranous appendages at the base of column; rostellum 2–3 mm, entire, with acute-acuminate apex; stigma lobes 2, closely placed, greenish white; anther cap 2.5–3 × 2.5–2.8 mm, 2-locular, lanceolate; pollinarium 3–3.5 mm, pollinia 2, yellow; ovary 0.8–1.2 × 0.15–0.22 cm including pedicel, fusiform, twisted, pubescent.

Phenology and distribution. *Odontochilus tetrapterus* was recorded to flower in November in Manipur, according to the type and protologue. The taxon is considered endemic (Pradhan, 1987) to this region in India.

Discussion. In 1977, 92 years after its type collection in 1885, Pradhan (1987) observed the existence of *Odontochilus tetrapterus* at a single locality in Manipur. However, this locality is vulnerable to disturbances, principally due to shifting cultivation. *Odontochilus tetrapterus* was treated (as *Anoectochilus tetrapterus*) as Vulnerable (VU) in the *1997 IUCN Red List of Threatened Plants* (Walter & Gillett, 1998) and as Vulnerable or possibly Endangered in the *Red Data Book of Indian Plants* (Pradhan, 1987). At present the existence of this species in nature is in doubt and needs confirmation.

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artist, Botanical Survey of India, Howrah, for making the illustration of *O. tetrapterus*.

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A New Species and Combination in Central American Solanaceae

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ABSTRACT. A new species of *Solanum* sect. *Geminata* (G. Don) Walp. (Solanaceae) from Costa Rica and Panama, *S. sotobosquense* Bohs, is described here from Limón, Costa Rica. It is morphologically most similar to *S. rovirosanum* Donn. Sm., but differs in its short, usually forked inflorescences and long fruiting pedicels. It has been named in honor of one of its collectors, D. Armando Soto, and in reference to its understory habitat. A new combination, *Cuatresia cuneata* (Standl.) Bohs, is also published here. Although based on the name *Lycianthes cuneata* Standl., this species has most commonly been considered to belong to the genus *Witheringia* L'Hér. Morphological and molecular data show that this species is a member of the genus *Cuatresia* Hunz., not *Witheringia*.

RESUMEN. Se describe aquí una especie nueva de *Solanum* sect. *Geminata* (G. Don) Walp. (Solanaceae), *S. sotobosquense* Bohs, de Limón, Costa Rica. Morfológicamente se parece a *S. rovirosanum* Donn. Sm., pero se diferencia por sus inflorescencias cortas y normalmente bifurcadas, y los pedicelos largos en fructificación. Ha sido nombrada en honor de uno de sus colectores, D. Armando Soto, y en referencia a su hábitat en el sotobosque. También se publica aquí una combinación nueva, *Cuatresia cuneata* (Standl.) Bohs. Aunque fue basado en el nombre *Lycianthes cuneata* Standl., ésta especie ha sido considerada comúnmente un miembro del género *Witheringia* L'Hér. Los datos morfológicos y moleculares muestran que ésta especie pertenece al género *Cuatresia* Hunz., no a *Witheringia*.

Key words: Costa Rica, *Cuatresia*, IUCN Red List, Panama, Solanaceae, *Solanum*, sect. *Geminata*, *Witheringia*.

A NEW SPECIES OF *SOLANUM* SECT. *GEMINATA*

Solanum L. (Solanaceae), with an estimated 1500 species, is one of the largest and most diverse genera of flowering plants (Frodin, 2004; Weese & Bohs, 2007). Within this genus, some of the most difficult species to identify are members of *Solanum* sect. *Geminata* (G. Don) Walp., which comprise over 120 taxa centered in the Neotropics. Knapp monographed this section in 2002, but more species in this group have been discovered since the publication of her careful treatment (Knapp, 2005, 2008; Nee et al., 2006; Granados-Tochoy et al., 2007). Concurrently, molecular data are helping to define the limits of the section and the phylogenetic relationships among its species. Published molecular phylogenetic studies identify a strongly supported group called the Geminata clade that conforms in most part to the traditional circumscription of the section (Bohs, 2005; Weese & Bohs, 2007; Knapp, 2008). Ongoing work is contributing to a detailed phylogeny of over half the species in the clade (Bohs et al., unpublished data). In addition, a large-scale project is underway to produce a species-level taxonomic treatment of the genus *Solanum* (Knapp et al., 2004; <http://www.nhm.ac.uk/solanaceaesource>). Together, all these activities are producing the most complete systematic picture of the genus *Solanum* ever attempted.

Work on the Solanaceae for the *Manual de Plantas de Costa Rica* (Bohs & Soto, in prep.) shows that the flora of this rather small country includes over 70 species of *Solanum*. While doing research on this flora, a new species of *Solanum* sect. *Geminata* was discovered. It is described here and compared with similar Central American species of the section.

Solanum sotobosquense Bohs, sp. nov. TYPE: Costa Rica. Limón: P. N. Cordillera de Talamanca, Talamanca, sendero de Quebrada Kuisa a Río Lori, entre Ujarrás y San José de Cabécar, 09°21′00″N, 83°13′20″W, 2000 m, 16 Mar. 1993 (fl., fr.), *G. Herrera 5903* (holotype, INB; isotypes, BM, CR, MO, USJ, UT). Figures 1–3.

Solano rovirosano Donn. Sm. simile, sed ab eo inflorescentiis brevibus plerumque furcatis et pedicellis fructiferis longis differt.

Shrub or small tree up to 6 m tall; stems scurfy, the surface irregularly cracking and peeling into small white or pale yellowish horizontal plates; sympodial units difoliate, geminate. Leaves simple, dimorphic, the larger blades 19–35 × 7–13 cm, ca. 2–3× as long as wide, elliptic to obovate, the smaller blades 2.5–7 × 2–4 cm, ca. 1–1.5× as long as wide, basically the same shape as the larger blades or somewhat more

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Figure 1. *Solanum sotobosquense* Bohs. —A, B. Habit. —C. Inflorescence. —D. Bud (left) and opened flower (right). —E. Gynoecium. —F. Stamens. —G. Infructescence and stem cross section. A–C from *Soto et al. 1226* (NY); D–F from *Hammel et al. 6493* (NY); G from *Hammel 6077* (NY).

rounded, subcoriaceous to somewhat fleshy, glabrous or very sparsely glandular-puberulent adaxially, glabrous to moderately puberulent abaxially on leaf veins and mesophyll with unbranched and often gland-tipped hairs, the midrib scurfy; base cuneate to decurrent; margin entire; apex acute or obtuse; petioles 1–5 cm, with scurfy surface like that of the stem. Inflorescences nearly sessile or up to 1 cm, leaf-

Figure 2. Armando Soto (left) and Lynn Bohs (right) with *Solanum sotobosquense* in the Parque Nacional Tapantí, Costa Rica.

opposed, usually forked, with 15 to 30+ flowers, all flowers apparently perfect, the axes scurfy; peduncle 0.1–0.5 cm; rachis 0.1–0.7 cm; pedicels 10–18 mm in flower, 20–35 mm in fruit, erect, with corky thickenings, contiguous and overlapping, articulated at the base. Flowers with the calyx 3–4 mm, the tube 1–2 mm, the lobes often unequal, 1–3 × ca. 2 mm, deltate, obtuse to mucronate at tips, glabrous to sparsely puberulent and often scurfy; fruiting calyx somewhat accrescent, the lobes ca. 3 × 2.5–3 mm, subtending but not covering the fruit; corolla 6–9 mm, 1–2 cm diam., stellate, subcoriaceous or fleshy, white, the tube 1–1.5 mm, the lobes 5–8 × 2–3 mm, lanceolate, glabrous abaxially and adaxially; stamens equal, with filaments connate at base, the tube ca. 1 mm, the free part 0.5–1 mm; anthers 3–4 × ca. 1.5 mm, oblong, not connivent, yellow, the pores large, directed distally, opening into longitudinal slits with age; ovary densely puberulent; style 4–7 × 0.2–0.4 mm, cylindrical, straight; stigma capitate. Fruits 0.6–1 cm diam., globose, green, densely glandular- and eglandular-puberulent when young, glabrous when older, held upright; seeds ca. 2 × 2 mm, ovoid-reniform, dark brown, the surface nearly smooth.

Distribution, habitat, and phenology. The new species is an uncommon understory shrub or small tree in rainforests and cloud forests of the Cordillera de Talamanca of southern Costa Rica and adjacent parts of Chiriquí Province, Panama, at 1500–2100 m in elevation. Flowering specimens have been collected in January, March, April, June, and November; fruiting specimens have been collected in February, March, and May.

IUCN Red List category. According to the IUCN Red List criteria (IUCN, 2001), *Solanum sotobosquense* is classified as VU B1a+2a; D1 (Vulnerable; extent of occurrence less than 20,000 km² and area of occupancy less than 2000 km², populations severely fragmented and known to exist at fewer than 10 locations, and population size estimated to number fewer than 1000 individuals). Populations of this species occur in protected areas of Parque Nacional Tapantí in Costa Rica and Parque Internacional La Amistad in Costa Rica and Panama and therefore are not perceived to be under direct threat at present.

Etymology. The epithet describes the habitat of this species, in the forest understory ("sotobosque" in

Figure 3. —A. Holotype of *Solanum sotobosquense* Bohs (*Herrera 5903*, INB). Inset: inflorescence detail. —B. Branch of *S. sotobosquense* showing paired (geminate) unequal leaves typical of the *S. arboreum* species group of Knapp (2002).

Spanish). It also commemorates Armando Soto, a Costa Rican Solanaceae specialist who guided the author to a population of this species in Parque Nacional Tapantí, Costa Rica.

Discussion. Specimens of this new taxon have been identified as *Solanum arboreum* Dunal, *S. narcoticosmum* Bitter, *S. roblense* Bitter, and *S. vacciniiflorum* Standl. & L. O. Williams by S. Knapp (pers. comm.) and others, but these specimens do not fit with the descriptions of any of those species. *Solanum sotobosquense* is densely puberulent on the new growth with minute glandular hairs and the leaf veins and mesophyll beneath are pubescent with unbranched, often gland-tipped hairs; the new growth and leaves of *S. narcoticosmum* are glabrous. It differs from *S. arboreum* in being a shrub or small tree (vs. a rhizomatous shrub). Its minutely glandular-puberulent fruits and large flowers distinguish it from *S. roblense*. *Solanum sotobosquense* lacks the distinctive hairs with reddish cross walls found in *S. vacciniiflorum*; the smaller, bullate leaves and deflexed fruiting pedicels of the latter species also help to distinguish the two species. The very long (20–35 mm), erect fruiting pedicels of *S. sotobosquense* differ from all the species mentioned above. *Solanum arboreum*, *S. narcoticosmum*, and *S. roblense* have erect fruiting pedicels up to about 20 mm long (to 25 mm in *S. narcoticosmum*; Knapp, 2002). The fruiting pedicels of *S. vacciniiflorum* range from 18 to 30 mm long, approaching the length of those of *S. sotobosquense*, but they are deflexed rather than erect.

Morphologically, *Solanum sotobosquense* is most similar to *S. rovirosanum* Donn. Sm. due to its large leaves, but the new species differs in its short, usually forked inflorescences (up to 1 cm long in *S. sotobosquense* vs. 1.5–8 cm long and often highly branched in *S. rovirosanum*) and long fruiting pedicels (20–35 mm long in *S. sotobosquense* vs. 8–13 mm long in *S. rovirosanum*).

Solanum sotobosquense exhibits a number of characters found in Knapp's *S. arboreum* species group, such as difoliate and geminate sympodial units with strongly dimorphic leaves, short inflorescences with overlapping pedicel scars, and erect fruiting pedicels. At least three other species of this group, *S. arboreum*, *S. ramonense* C. V. Morton & Standl., and *S. roblense*, have similar scurfy stems, major leaf veins, and inflorescence axes, where the surface cracks and

peels into small plates. Molecular data (Bohs et al., unpublished) indicate that *S. sotobosquense* may be most closely related to *S. arboreum*, *S. ramonense*, and *S. roblense* and is only distantly related to *S. rovirosanum* despite its morphological similarity to the latter species.

Paratypes. COSTA RICA. **Cartago:** ca. 15 km S of Tapantí along new rd. on E slope above Río Grande de Orosí near concrete bridge, 09°42′N, 83°47′W, 1500 m, 13 Mar. & 14 Apr. 1973 (fl.), *J. L. Gentry & W. C. Burger 2636* (MO); Parque Nac. Tapantí, Río Dos Amigos at river crossing on second concrete bridge, 1600 m, 9°41′38.9″N, 83°46′58.6″W, 11 Jan. 2006 (fl.), *D. A. Soto, L. Bohs & J. Sperry 1226* (INB, MO, NY, UT). PANAMA. **Chiriquí:** vic. of Boquete, Cerro Pate de Macho, upper NE slopes & along soggy ridge of Cont. Divide, 08°46′N, 82°25′W, 1900 2000 m, 19 June 1987 (fl.), *T. Croat 66446* (NY); region of Boquete, Cerro Horqueta, 6500 ft., 8 May 1940 (fr.), *C. & W. von Hagen 2084* (MO, NY); along trail from end of Río Palo Alto rd. to Chiriquí border with Bocas del Toro Prov. near peak of Cerro Pate Macho, 6200 ft., 20 Nov. 1978 (fl.), *B. Hammel 5820* (NY); NE of Boquete, end of rd. past Palo Alto along trail to Bocas past Cerro Pate Macho, 6200 6500 ft., 9 Feb. 1979 (fr.), *B. Hammel 6077* (NY); end of rd. past Palo Alto to Bocas, 6500 ft., 18 Mar. 1979 (fl., fr.), *B. Hammel et al. 6493* (MO, NY); trail to Cerro Pate Macho, headwaters of Río Palo Alto, above Palo Alto, 08°47′N, 82°22′W, 1700 2100 m, 15 Mar. 1982 (fl.), *S. Knapp, W. J. Kress & B. Hammel 4265* (NY); rd. to Cerro Punta Natl. Park from Alto Quiel & Boquete, 08°51′N, 82°29′W, ca. 1850 m, 16 Jan. 1986 (fl.), *G. McPherson 8040* (NY).

Transfer of *Witheringia cuneata* to *Cuatresia*

The tribe Physaleae Miers of the Solanaceae includes about 200 species divided into approximately 25 genera (Olmstead et al., 2008). Generic circumscriptions and phylogenetic relationships within this group have been uncertain, and taxonomic concepts have varied widely among previous workers. For instance, Hunziker (2001) placed *Cuatresia* Hunz. and *Witheringia* L'Hér. together with seven other genera in subtribe Witheringinae. However, recent molecular analyses show that *Cuatresia* and *Witheringia* are clearly distinct phylogenetically (Olmstead et al., 2008). The species commonly known as *W. cuneata* (Standl.) Hunz. was included in this study, and it emerged in a strongly supported clade with *C. exiguiflora* (D'Arcy) Hunz. and *C. riparia* (Kunth) Hunz. and not with the other four species of *Witheringia* sequenced. Furthermore, the glabrous and somewhat rubbery-textured leaves of *W. cuneata* are typical of species of *Cuatresia*, as are the dull yellow coriaceous corollas. It is thus clear that *W. cuneata* should be transferred to the genus *Cuatresia*.

Cuatresia cuneata (Standl.) Bohs, comb. nov.
Basionym: *Lycianthes cuneata* Standl., Publ. Field Columbian Mus., Bot. Ser. 4(8): 260. 1929. *Witheringia cuneata* (Standl.) Hunz., Kurtziana 5: 118. 1969. TYPE: Panama. Bocas del Toro: Research Lagoon, region of Almirante, Jan.–Mar. 1928, *G. P. Cooper 405* (holotype, F 579181; isotypes, K, NY, US).

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Typifications and New Synonymies in *Capanemia* (Orchidaceae, Oncidiinae)

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Abstract. *Capanemia* Barb. Rodr. (Orchidaceae, Oncidiinae) currently includes 17 epiphytic, predominantly Brazilian species. As part of an ongoing revision of this genus, we herein propose new synonyms and typifications for several taxa. After a thorough revision of both herbarium material and many living specimens in cultivation collected in southern and southeastern Brazil, we herein recognize only seven species, six of which are treated here: *C. brachycion* (Griseb.) Schltr., *C. carinata* Barb. Rodr., *C. gehrtii* Hoehne, *C. micromera* Barb. Rodr., *C. superflua* (Rchb. f.) Garay, and *C. therezae* Barb. Rodr; the seventh species, *C. adelaidae* Porto & Brade, is recognized as valid but not treated here, since no taxonomic or nomenclatural problems were detected regarding this species. New synonymies are proposed: *C. ensata* Pabst is referred to *C. gehrtii*; *C. angustilabia* Schltr., *C. australis* (Kraenzl.) Schltr., *C. lossiana* L. Kollmann, *C. perpusilla* Schltr., *C. riograndensis* Pabst, and *C. spathuliglossa* Pabst are referred to *C. micromera*; and *C. fluminensis* Pabst is referred to *C. therezae*. Lectotypes are proposed for *C. angustilabia*, *C. carinata*, *C. micromera*, *C. perpusilla*, *C. spathuliglossa*, and *C. therezae*. A neotype is proposed for *C. hatschbachii* Schltr.

Resumo. Atualmente, o gênero *Capanemia* Barb. Rodr. (Orchidaceae, Oncidiinae) inclui 17 espécies epifíticas e predominantemente brasileiras. Como parte da revisão deste gênero, propomos aqui novas sinonímias e tipificações para muitos taxa. Após uma cuidadosa revisão de material de herbário e de muitos espécimes vivos cultivados, coletados na região sul e sudeste do Brasil, reconhecemos como válidas um total de sete espécies, seis das quais são tratadas aqui: *C. brachycion* (Griseb.) Schltr., *C. carinata* Barb. Rodr., *C. gehrtii* Hoehne, *C. micromera* Barb. Rodr., *C. superflua* (Rchb. f.) Garay e C. *therezae* Barb. Rodr.; a sétima espécie, *C. adelaidae* Porto & Brade, é reconhecida como válida mas não é tratada aqui, pois não foram detectados problemas taxonômicos ou nomenclaturais sobre esta espécie. Novas sinonímias são propostas: *C. ensata* Pabst é sinonimizada com *C. gehrtii*; *C. angustilabia* Schltr., *C. australis* (Kraenzl.) Schltr., *C. lossiana* L. Kollmann, *C. perpusilla* Schltr., *C. riograndensis* Pabst e *C. spathuliglossa* Pabst com *C. micromera*; e *C. fluminensis* Pabst com *C. therezae*. São propostos lectótipos para *C. angustilabia*, *C. carinata*, *C. micromera*, *C. perpusilla*, *C. spathuliglossa* e *C. therezae*. Propõe-se um neótipo para *C. hatschbachii* Schltr.

Key words: *Capanemia*, Orchidaceae, Oncidiinae.

Capanemia Barb. Rodr. (Orchidaceae, Oncidiinae) was proposed by João Barbosa Rodrigues (1877) honoring Guilherme Schüch, the Baron of Capanema, his patron and benefactor (Sá, 2001). Barbosa

Rodrigues (1877: 137–138) originally described two species (*C. uliginosa* Barb. Rodr. and *C. micromera* Barb. Rodr., respectively) without specifying the type of the genus. He later described two additional species (Barbosa Rodrigues, 1882: 243–244), again without citing a type for the genus.

All *Capanemia* species are small epiphytes (1–9.5 cm high) with sympodial growth. The roots are long, flexuous, and glabrous; the pseudobulbs are ovate to clavate and smooth to sulcate; and the sheaths surrounding the pseudobulbs may be articulated (*C. micromera* and *C. therezae* Barb. Rodr.) or not (*C. adelaidae* Porto & Brade, *C. gehrtii* Hoehne, and *C. superflua* (Rchb. f.) Garay). The leaves can be conduplicate or acicular to terete. The inflorescences are lateral, racemose, erect or pendulous, covered by articulated or membranous bracts, with a variable number of flowers (two to 20). The flowers are small (to 12 mm long), white or green, quite often with yellow dots between the two labellar calli.

In previous works, the genus included 17 predominantly Brazilian species (Pabst, 1972; Kollmann, 2007) that generally dwell at 450–1400 m. Some taxa extend their ranges to Bolivia, southeastern Paraguay, northern Argentina, and northern and northeastern Uruguay. *Capanemia brachycion* (Griseb.) Schltr., which ranges from Bolivia to Paraguay and northeastern Argentina, is the sole species that has never been collected in Brazil, where the genus occurs from the states of Rio Grande do Sul to Bahia (Pabst, 1972; Pabst & Dungs, 1977: 200; A. L. V. Toscano de Brito, pers. comm.). These minute epiphytes are found in small populations in rainforests, and generally herbarium collections are rare. Furthermore, most specimens are only identified to the rank of genus and few are referred to the correct species because most features used for their identification are inconsistent and/or obscure (Pabst, 1972; Pabst & Dungs, 1975, 1977).

Barbosa Rodrigues (1877, 1882), following standard rules of his time, cited localities and flowering times for his plants, but did not designate types for his new species. However, he did cite watercolors he had prepared to illustrate his work, which he planned to publish as *L'Iconographie des Orchidées du Brésil* (Barbosa Rodrigues, 1877: 5, footnote). These watercolors remained unpublished until Cogniaux used them as the basis for line drawings in his Orchidaceae for Martius's *Flora Brasiliensis* (Cogniaux, 1893–1906). Many years later, Barbosa Rodrigues's original watercolor plates were published in color (Sprunger et al., 1996). The original illustrations prepared by Barbosa Rodrigues are currently in Brazil (vols. 1–3, 5, and 6, see below) and at the Orchid Herbarium of Oakes Ames, Harvard University Herbaria (vol. 4).

There is much controversy surrounding Barbosa Rodrigues's (1877, 1882) work. Some researchers have cast doubt on the existence of pressed herbarium materials, but it is generally believed that the pressed vouchers existed and were accidentally destroyed (Cribb & Toscano, 1996). In fact, according to notes made in his personal copy of *Genera et Species Orchidacearum Novarum* (at the Orchid Herbarium of Oakes Ames, Harvard University Herbaria), Oakes Ames visited Barbosa Rodrigues's widow in 1915 accompanied by Johan A. C. Löfgren and Paulo Campos Porto; during this visit Ames found out "...that the bulk of the Rodrigues Herbarium [had been] destroyed by an inundation of the basement of his house during a terrific tropical deluge."

A thorough revision of foreign and Brazilian herbaria has not revealed any type material of Barbosa Rodrigues's species. Therefore, for *Capanemia*, we herein designate Barbosa Rodrigues's original illustrations as lectotypes for three species. These watercolors are part of volume 6 of his unpublished work deposited at the Biblioteca Barbosa Rodrigues, which is part of the Jardim Botânico do Rio de Janeiro. Photos of these original artworks as well as any other type materials cited in this contribution are available on request.

As mentioned above, Barbosa Rodrigues did not specify the type of *Capanemia*. Pabst (1972) designated *C. micromera* as the lectotype, judging that this species shares important vegetative and floral features with others in the genus. Herein, we accept *C. micromera* as the type species, in agreement with Pabst (1972).

About half of the described species are only known from their type collections, and the genus as a whole is poorly known. The revision of herbarium material (including the types), as well as the analysis of many live, cultivated specimens collected in southern and southeastern Brazil, led us to conclude that there is a great deal of phenotypic plasticity and that the current circumscription of *Capanemia* inflates the number of species in the genus.

A monograph of *Capanemia* is needed. Pabst (1972) published a synopsis, but did not clarify the status of doubtful species and did not explicitly explain the choice of the few types he selected. Pabst (1972) accepted 16 species and divided them into two sections, based on the shape of the leaves: section *Capanemia* (with acicular-terete leaves) and section *Planifolia* Pabst (with conduplicate leaves). Within Pabst's sections, species are separated based on

labellum features, mainly the shape of the callus. A molecular phylogeny of the genus is in progress (Buzatto et al., in prep.) that will test the monophyly of these sections. Recent work (Kollmann, 2007) is limited to the morphological description of new species. We do accept the synonymy previously proposed by Pabst (1972). However, further studies indicate that more species were based on phenotypical variations that can be found within populations. Therefore, we herein recognize only seven species, six of which are treated here: *C. brachycion*, *C. carinata* Barb. Rodr., *C. gehrtii*, *C. micromera*, *C. superflua*, and *C. therezae*; the seventh species, *C. adelaidae*, is recognized as valid but not treated here, since no taxonomic or nomenclatural problems were detected regarding this species.

Capanemia Barb. Rodr., Gen. Sp. Orchid. 1: 137. 1877. TYPE: *Capanemia micromera* Barb. Rodr. (lectotype, designated by Pabst [1972: 217]).

1. Capanemia brachycion (Griseb.) Schltr., Repert. Spec. Nov. Regni Veg. 15: 148. 1918. Basionym: *Sigmatostalix brachycion* Griseb., Abh. Königl. Ges. Wiss. Göttingen 24: 336. 1879. TYPE: Argentina. Jujuy: Piedra Pintada, Las Capillitas, 28 Apr. 1873, *P. G. Lorentz & A. G. Hieronymus 976* (holotype, GOET; isotypes, CORD not seen [CORD photo as HB 58690], HB 58690, NY 5182).

Additional specimens examined. BOLIVIA. **Tarija:** Ruta Tarija, *A. Krapovickas et al. 18968* (CTES). PARAGUAY. s. loc., s.d., *C. E. O. Kuntze s.n.* (NY); s. loc., s.d., s. coll. (K).

2. Capanemia carinata Barb. Rodr., Gen. Sp. Orchid. 2: 243. 1882. TYPE: Brazil. "Hab. croissant dans les forêts qui bordent les ruisseaux dans la Serra da Mantiquyra près Sitio," s.d., *J. Barbosa Rodrigues s.n.* (holotype, presumed lost; lectotype, designated here, tab. 311, fig. B in Barbosa Rodrigues's *L'Iconographie des Orchidées du Brésil*, vol. 6 [original illustration at Biblioteca Barbosa Rodrigues at the Jardim Botânico do Rio de Janeiro, holotype cited as tab. 597 (unpublished) in Barbosa Rodrigues (1882)], reproduced in Sprunger et al. [1996, vol. 1: 439, fig. B]). EPITYPE: [Brazil.] s. loc., s.d., *C. Spannagel 244* (epitype, designated here, SP 25651, cited as tab. 246 in Hoehne [1949, vol. III: 227]).

Discussion. Barbosa Rodrigues's original illustration, deposited at the Biblioteca Barbosa Rodrigues at the Jardim Botânico do Rio de Janeiro, was first reproduced by Cogniaux (1904, as a black-and-white ink drawing) and later by Sprunger et al. (1996, in color). We herein designate this original artwork as lectotype.

Because Barbosa Rodrigues's original illustration only shows the perianth, we propose an epitype, cited and illustrated by Hoehne (1949) in his influential *Iconografia de Orchidaceas do Brasil*. We believe that the specimen collected by Spannagel is fully representative of the taxon. Indeed, it shows both flower and vegetative features that supplement the original description.

3. Capanemia gehrtii Hoehne, Arq. Bot. Estado São Paulo 1: 43. 1939. TYPE: Brazil. Minas Gerais: Delfim Moreira, 21 Apr. 1939, *A. Gehrt s.n.* (holotype, SP 40502; isotype, RB 87645).

Capanemia ensata Pabst, Anais 15 Congr. Soc. Bot. Brasil 113. 1967, syn. nov. TYPE: Brazil. Minas Gerais: Cariaçú, July 1954, *N. Welter 15* (holotype, HB 2473).

Discussion. After an analysis of the holotype of *Capanemia ensata*, we conclude that this species is referable to *C. gehrtii*.

Additional specimens examined. BRAZIL. **Espírito Santo:** Domingos Martins, *R. A. Kautsky s.n.* (HB). **Minas Gerais:** Baipendí, *G. F. J. Pabst 4145* (HB). **Paraná:** Jundiaí do Sul, *J. Cordeiro 219* (MBM); Tibají, *G. Hatschbach 3307* (MBM). **Rio de Janeiro:** Rio de Janeiro, *Janilson 2004* (RB). **Rio Grande do Sul:** Santa Cruz do Sul, *J. L. Waechter 296* (ICN); São Sebastião do Caí, *J. Dutra 1186* (ICN, RB). **Santa Catarina:** Florianópolis, *J. A. Rohr 2339* (HB).

4. Capanemia micromera Barb. Rodr., Gen. Sp. Orchid. 1: 138. 1877. TYPE: Brazil. Minas Gerais: "Sur les bords de la rivière Dourado, affluent de la rivière Sapucahy," s.d., *J. Barbosa Rodrigues s.n.* (holotype presumed lost; lectotype, designated here, tab. 311, fig. A, in Barbosa Rodrigues's *L'Iconographie des Orchidées du Brésil*, vol. 6 [original illustration at Biblioteca Barbosa Rodrigues at the Jardim Botânico do Rio de Janeiro, holotype cited as tab. 355 (unpublished) in Barbosa Rodrigues (1877)], reproduced in Sprunger et al. [1996, vol. 1: 439, fig. A]). EPITYPE: Brazil. Minas Gerais: Caldas, 6 Aug. 1855, *A. F. Regnell III 1172* (epitype, designated here, S 08–2804, cited by Cogniaux [1904: 199], as *Quekettia micromera* var. *major* Cogn.).

Capanemia australis (Kraenzl.) Schltr., Repert. Spec. Nov. Regni Veg. Beih. 35: 92. 1925, syn. nov. Basionym: *Quekettia australis* Kraenzl., Repert. Spec. Nov. Regni Veg. 2: 57. 1906. TYPE: Brazil. Rio Grande do Sul: Panambi, 12 Sep. 1904, *A. Bornmüller 142* (holotype, NY 547403; isotype, A 176406, B 10 0247538, F

232179, G 152056/1 not seen, GH 176406, L U0005416, NY 547404, W 1916 6706).

Capanemia perpusilla Schltr., Orchis 8: 135 136. 1914, syn. nov. TYPE: Brazil. s. loc., s.d., s. coll., s.n. (lectotype, designated here, fig. 4 in Schlechter [1914: 135]).

Capanemia angustilabia Schltr., Repert. Spec. Nov. Regni Veg. 23: 60. 1926, syn. nov. TYPE: Brazil. Paraná: Curitiba, s.d., *A. Hatschbach 79* (lectotype, designated here, tab. 222 in Schlechter [1930]).

Capanemia spathuliglossa Pabst, Arch. Jard. Bot. Rio de Janeiro 14: 24. 1956, syn. nov. TYPE: Brazil. Rio Grande do Sul: Caxias do Sul, s.d., *I. Bento 64* (lectotype, designated here, HB 139).

Capanemia riograndensis Pabst, Orquideologia 7: 240. 1972, syn. nov. TYPE: Brazil. Rio Grande do Sul: Canela, s.d., *E. Richter s.n.* (holotype, HB 2145).

Capanemia lossiana L. Kollmann, Bol. Mus. Biol. Mello Leitão 22: 6. 2007 [2008], syn. nov. TYPE: Brazil. Espírito Santo: Santa Maria de Jetibá, São José do Rio Claro, 3 June 2001, *L. Kollmann, A. Loss-Filho & J. A. R. Santos 4308* (holotype, MBML 36250).

Discussion. Cogniaux (1904: 198) referred *Capanemia micromera* to *Quekettia* Lindl. and on the following page cited *A. F. Regnell III 1172* under his variety *major*. We examined the specimen cited above, and it is complete and well preserved.

After the analysis of the types of *Capanemia australis*, *C. perpusilla*, *C. angustilabia*, *C. spathuliglossa*, *C. riograndensis*, and *C. lossiana*, as well as several living specimens collected near their type localities, we conclude that these species simply represent phenotypical variations of *C. micromera*.

Some specimens of *Capanemia angustilabia* were sent to R. Schlechter (B) by Albino Hatschbach Sobrinho for cultivation and further description of the taxon. However, the type collection was lost during World War II (G. Hatschbach, pers. comm.). This may be the same possible reason for the loss of the *C. perpusilla* type, for which it was impossible to find paratypes, syntypes, or isotypes, or illustrations of Rudolf Schlechter. These taxa are not cited in what remains of Schlechter's type collection, in Berlin-Dahlem Herbarium (Butzin, 1978). Therefore, we here designate Schlechter's illustration published in 1930 (tab. 222) as a lectotype of *C. angustilabia* (Schlechter, 1930), and the original illustration (cited as "Tafel 4" in the protologue of this taxon) as the lectotype of *C. perpusilla* (Schlechter, 1914).

Regarding *Capanemia angustilabia*, the illustration may be considered a lectotype rather than a neotype for several reasons. The species was described in 1926 based on a single specimen as type (*A. Hatschbach 79*, B†). Its illustration was published later (1930) in the same journal (Schlechter, 1930). The protologue does not mention any voucher other than the type, and we were unable to find any other pressed specimens either related to the protologue or not. There is no reason to think that Schlechter's illustration was based on any specimen other than *A. Hatschbach 79*, and the illustration itself does not provide any information regarding the specimen on which it was based. Even if the illustration was published in 1930, four years after the protologue, which did not illustrate *C. angustilabia*, it likely follows Schlechter's publication plan, giving continuity to his work. Therefore, we consider the most parsimonious option to designate the illustration as the lectotype, since it may be based on the lost holotype (*A. Hatschbach 79*).

The type of *Capanemia spathuliglossa* was originally deposited at the Instituto Geobiológico La Salle Herbarium. All collections in this herbarium were transferred to ICN during the 1990s, but part of this material was lost or had a doubtful fate (S. A. L. Bordignon, pers. comm.). Among those materials lost was the *C. spathuliglossa* type. However, during our review of the HB collection, a specimen labeled HB 139 of *C. spathuliglossa* was found. Because the herbarium number and provenance are in agreement with those specified in the protologue (Pabst, 1956), we consider the specimen at HB to be part of the original gathering and propose it as lectotype here. Only the collection number differs (*I. Bento 62* vs. *I. Bento 64* as cited in the protologue), but we attribute the difference to a typographical error.

Additional specimens examined. ARGENTINA. **Corrientes:** Dpto. San Miguel, *T. M. Pedersen 13919* (NY). **Jujuy:** Dpto. Capital, *A. Schinini et al. 10293* (CTES). **Misiones:** Dpto. Iguazú, *A. E. J. 470* (CTES). BRAZIL. **Espírito Santo:** Caxixe Frio, *R. Kautsky 403* (HB); Santa Maria de Jetibá, *R. R. Santos s.n.* (MBML). **Minas Gerais:** Caldas, *A. F. Regnell III 1172* (S); Poços de Caldas, *F. C. Hoehne 1920* (SP); São Lourenço, *G. F. J. Pabst 4273* (HB). **Paraná:** Almirante Tamandaré, *G. Hatschbach & O. Guimarães 24521* (MBM); Araucária, *J. T. Motta 408* (MBM); Balsa Nova, *G. Hatschbach 24722* (NY); Capão Grande, *P. Dusén 8512* (S); Curitiba, *R. Lange & P. Dusén 8512* (NY, S); Foz do Iguaçu, *E. Bottura 1054* (MBM); Inácio Martins, *G. Hatschbach & O. Guimarães 30339* (MBM); Lapa, *P. I. Oliveira 622* (MBM); Piraquara, *G. Hatschbach 107* (MBM); Rio Negro, *F. C. Hoehne 1928* (SP); São José dos Pinhais, *G. Hatschbach 16719* (MBM); Tibají, *G. Hatschbach & O. Guimarães 14669* (MBM); Vila Velha, *M. Kuhlmann 2* (SP). **Rio de Janeiro:** Rio de Janeiro, *A. C. Brade 1934* (RB). **Rio Grande do Sul:** Aratiba, *D. E. Nava* 1994 (PEL); Barracão, *J. Spanholi 2000* (HAS); Cambará do Sul, *C. R. Buzatto 372* (ICN); Carazinho, *J. L. Waechter 2344* (ICN); Cerro Largo, *E. Friederichs SJ 1944* (PACA); Condor, *C. R. Buzatto 356* (ICN); Eldorado do Sul, *C. Giongo & Kuwppi 261* (ICN); Esmeralda, *R. Wasum et al. 3232* (CTES, MBM); Farroupilha, *Camargo 1890* (PACA); Guaíba, *V. F. Nunes 1419* (ICN); Muitos Capões, *C. R. Buzatto 432* (ICN); Paraíso do Sul, *C. R. Buzatto 394* (ICN); Passo Fundo, *C. R. Buzatto 389* (ICN); Piratini, *C. A. M. Lindman A943* (S); Santa Bárbara do Sul, *C. R. Buzatto 357* (ICN); Santa Cruz do Sul, *J. L. Waechter 1328* (ICN); São Francisco de Paula, *C. R. Buzatto 354* (ICN); São José dos

Ausentes, *C. R. Buzatto 486* (ICN); São Leopoldo, *J. Dutra 1002* (HB, ICN); Tenente Portela, *J. L. Waechter 1663* (ICN); Torres, *J. L. Waechter 1676* (ICN); Vacaria, *C. R. Buzatto 355* (ICN); Vera Cruz, *C. R. Buzatto 393* (ICN); Viamão, *J. L. Waechter 300* (ICN). **Santa Catarina:** Abelardo Luz, *R. M. Klein 5547* (HBR); Caçador, *R. Reitz & R. M. Klein 13181* (HBR); Campos Novos, *R. Reitz & R. M. Klein 16160* (B, HBR, MBM, NY, PACA, RB); Canoinhas, *R. M. Klein 3001* (HB); Capão Alto, *C. R. Buzatto 427* (ICN); Curitibanos, *R. M. Klein 3137* (HBR); Iraní, *R. M. Klein 5495* (HBR, PACA); Lages, *C. R. Buzatto 435* (ICN); Papanduva, *R. M. Klein 2988* (HBR, K, MBM); Ponte Alta, *R. M. Klein, Legrand & Marcheri 9670* (HB, HBR); Porto União, *R. M. Klein 3061* (HBR, ICN, K, MBM, NY, PACA); Rio do Sul, *R. Reitz & R. M. Klein 17054* (HBR); Urubicí, *C. R. Buzatto 424* (ICN); Valões, *R. M. Klein 3032* (HB, HBR). **São Paulo:** Campinas, *A. F. Regnell 2020* (S); Iperó, *G. Edwall 27265* (NY). PARAGUAY. **Guairá:** Villa Rica, *C. A. M. Lindman A1753* (S). **Presidente Hayes:** Estancia Vista Alegre, *T. Rojas 3835* (SP).

5. Capanemia superflua (Rchb. f.) Garay, Bot. Mus. Leafl. 21: 261. 1967. Basionym: *Oncidium superfluum* Rchb. f., Ann. Bot. Syst. 6: 721. 1863. TYPE: Brazil. Minas Gerais: s. loc., 1845–1846, *J. F. Widgren 778* (holotype, K-L; isotype, UPS).

Discussion. Kränzlin (1922: 95) could not find the type of *Oncidium superfluum* in the Reichenbach Herbarium at Naturhistorisches Museum Wien and he listed it, with two others, as "especies nomina dubiae." Garay (1967: 261), however, stated that "the holotype of *Oncidium superfluum* [was] in the Kew Herbarium." The specimen in the Lindley Herbarium at K cited above agrees with the information cited by Garay. It bears a label typical of those written by H. Gustav Reichenbach, a drawing of a flower by John Lindley, and two annotations by R. A. Rolfe, one referring it to "*Rodriguezia anomala*, Rolfe," the other to "*Capanemia uliginosa*, Rodr." Although the specimen does not have any annotations made by Reichenbach f. (other than the label), we herein follow Garay (1967) and accept it as the holotype.

Additional specimens examined. ARGENTINA. **Misiones:** Dpto. Guaraní, *S. G. Tressens et al. 5968* (CTES). BRAZIL. **Espírito Santo:** Domingos Martins, *R. Kautsky 74* (HB). **Minas Gerais:** Caldas, *A. F. Regnell 1168* (S); Poços de Caldas, *M. Emmerich 1967* (HB). **Paraná:** Bituruna, *G. Hatschbach 15093* (MBM); Clevelândia, *G. Hatschbach 22699* (CTES, MBM, UPCB); Curitiba, *G. Hatschbach 40259* (MBM); Iratí, *P. Dusén 7332A* (S); Jaguariahyva, *P. Dusén 1910* (S); Palmas, *J. M. Silva & C. B. Poliquesi 4454* (MBM); Palmeira, *G. Hatschbach 45738* (MBM); Pato Branco, *G. Hatschbach 3513* (MBM); Pinhão, *O. S. Ribas 332 & G. C. Gilberti* (MBM); Ponta Grossa, *P. Dusén 8885* (K, NY, S); Porto Amazonas, *P. Dusén 1909* (S); Rio Negro, *C. Spannagel 200* (SP); São José dos Pinhais, *G. Hatschbach 757* (MBM); Tibají, *G. Hatschbach 59684 & F. Deodato* (MBM); Teresina, *P. Dusén 1911* (S); União da Vitória, *H. Rodrigues Jr., J. Angely & G. Hatschbach 3515* (MBM); Ventania, *J. Cordeiro 752* (MBM). **Rio Grande do Sul:** Bento Gonçalves, *A. Sehnem 7211* (PACA); Canela, *J. Meyer 178 et al.* (HAS); Caxias do Sul, *C. R. Buzatto 428* (ICN); Esmeralda, *J. L. Waechter 1905* (ICN); Flores da Cunha, *R. Wasum et al. 1186* (MBM); Garibaldi, *Camargo 2310* (B), Itaara, *T. B. Breier 1998* (SMDB); Mato Castelhano, *C. R. Buzatto 29* (ICN, RSPF); Montenegro, *A. Sehnen 4019* (B); Passo Fundo, *C. R. Buzatto 525* (ICN); Porto Alegre, *C. Orth 1932* (B); Putinga, *T. Klein 2002* (Herbário do Museu de Ciências Naturais da UNIVATES); Rio Pardo, *J. Dutra 41* (ICN); Santa Cruz do Sul, *J. L. Waechter 1789* (HAS, ICN); São Francisco de Paula, *G. Grazziotin et al. 3547* (MBM); São Leopoldo, *J. Dutra 1119* (ICN); Tenente Portela, *J. L. Waechter 376* (ICN); Veranópolis, *N. Silveira 425* (HAS). **Santa Catarina:** Abelardo Luz, *L. B. Smith & R. Reitz 12818* (HBR, K, NY, S); Bom Retiro, *R. Reitz 6038* (HBR); Campos Novos, *R. M. Klein 4235* (HBR, MBM, RB); Catanduvas, *L. B. Smith & R. M. Klein 12986* (B, HBR, NY); Chapecó, *R. Reitz 4802* (HBR); Curitibanos, *R. M. Klein 4062* (HBR); Lages, *R. M. Klein 3183* (B, HBR, MBM); Ponte Alta, *H. S.R.R. 1969* (HB); Urubici, *G. Hatschbach, A. Cervi & E. Barbosa 72532* (MBM, UPCB).

6. Capanemia therezae Barb. Rodr., Gen. Sp. Orchid. 2: 244. 1882, as "*Capanemia therasiae*." TYPE: Brazil. "croissant sur les arbres du Parc Imperial, à Petropolis..." s.d., *J. Barbosa Rodrigues s.n.* (holotype, presumed lost; lectotype, designated here, tab. 311, fig. C, in Barbosa Rodrigues's *L'Iconographie des Orchidées du Brésil*, vol. 6 [original illustration at Biblioteca Barbosa Rodrigues at the Jardim Botânico do Rio de Janeiro, holotype cited as tab. 810 (unpublished), Barbosa Rodrigues (1882)], reproduced in Sprunger et al. [1996, vol. 1: 439, fig. C]).

Capanemia hatschbachii Schltr., Repert. Spec. Nov. Regni Veg. 23: 60. 1926. TYPE: Brazil. Paraná: Curitiba, Batel, Aug. 1945, *C. Steufeld 1168* (neotype, designated here, MBM 213769).

Capanemia duseniana (Kraenzl.) Porto & Brade, Rodriguésia 1: 20. 1935. Basionym: *Quekettia duseniana* Kraenzl., Ark. Bot. 16(8): 24. 1921. TYPE: Brazil. Paraná: Curitiba, s.d., *P. Dusén & R. Lange 8529* (holotype, S R-5406; isotypes, HB 153, HB 41003, K 36587, MBM 215406, MBM 213770).

Capanemia fluminensis Pabst, Orquideología 7: 223. 1972, syn. nov. TYPE: Brazil. Rio de Janeiro: Petrópolis, Itaipava, 2 July 1957, *G. F. J. Pabst 4269* (holotype, HB 3666).

Discussion. The specific epithet of this taxon honors Imperatriz D. Thereza Christina Maria. However, as originally published ("*therasiae*"), its spelling is not in agreement with nomenclatural recommendation. Therefore, we adjust its orthography as *Capanemia therezae*, following Recommendation 60C.1(a) in the *International Code of Botanical Nomenclature* (McNeill et al., 2006).

We herein propose *Steufeld 1168* (MBM 213769) as the neotype of *Capanemia hatschbachii*. This exsiccata comes from the type locality and is fully in agreement with the protologue. The type material (Brazil. Paraná: Curitiba, s.d., *A. Hatschbach 123*) was destroyed at B during World War II, and it was impossible to find any potential candidates for lectotypification. Furthermore, the original description by Rudolf Schlechter lacks an illustration that could be designated as lectotype.

When reviewing the collections at MBM and HB, we found three collections of *Dusén & Lange 8529* referable to *Quekettia duseniana* Kraenzl. [= *Capanemia duseniana* (Kraenzl.) Porto & Brade]. Collector data on these specimens are in full agreement with the holotype, and we thus cite them as isotypes.

After the analysis of the type of *Capanemia fluminensis* (*G. F. J. Pabst 4269*, HB) we conclude that this taxon just represents phenotypical variations of *C. therezae*.

Additional specimens examined. BRAZIL. **Espírito Santo:** Vargem Alta, *A. C. Brade 1949* (RB). **Paraná:** Araucária, *R. A. Kersten & Silva 414* (UPCB); Campina Grande do Sul, *G. Hatschbach 8319* (MBM); Colombo, *P. R. P. Andrade s.n.* (MBM); Curitiba, *C. R. Buzatto 395* (ICN); Ipiranga, *P. Dusén 10182* (S); Piraquara, *G. Hatschbach 1528* (HB, MBM). **Rio de Janeiro:** Nova Friburgo, *E. Amarante 1936* (RB); Teresópolis, *A. Abendrith P62* (HB). **Rio Grande do Sul:** Bom Jesus, *J. Dutra 1020* (ICN); Cambará do Sul, *C. R. Buzatto 398* (ICN); Canela, *E. Richter 1960* (HB); Esmeralda, *J. L. Waechter 1255* (ICN); São Francisco de Paula, *C. R. Buzatto 364* (ICN); São José dos Ausentes, *C. R. Buzatto 489* (ICN). **Santa Catarina:** Capão Alto, *C. R. Buzatto 426* (ICN); São Joaquim, *C. R. Buzatto 438* (ICN). **São Paulo:** São Paulo, *F. C. Hoehne 258* (NY); Vila Emma, *A. C. Brade 16731* (RB).

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Taxonomic Notes for *Salvia aucheri* (Lamiaceae) from Southern Anatolia, Turkey

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ABSTRACT. *Salvia aucheri* Benth. (Lamiaceae) is a species endemic to Turkey, and the name is lectotypified herein. Two varieties were previously recognized, as *S. aucheri* var. *aucheri* and *S. aucheri* var. *canescens* Boiss. & Heldr.; the infraspecific taxa are recognized here as subspecies. During revisionary work on Turkish *Salvia* L., we determined that *S. aucheri* subsp. *canescens* (Boiss. & Heldr.) Celep, Kahraman & Doğan differs from subspecies *aucheri* not only morphologically, but also geographically and phenologically, and both taxa are typically allopatric.

Key words: Lamiaceae, *Salvia*, Turkey.

The genus *Salvia* L. (Lamiaceae) was first treated for Turkey by Hedge (1982) in Davis's *Flora of Turkey and the East Aegean Islands*, in which 86 species were recognized. Since 2005, extensive field surveys and laboratory studies have been conducted on *Salvia* in Turkey by the authors (Celep & Doğan, 2009; Celep et al., 2009; Ilcim et al., 2009; Kahraman et al., 2009). Among these species, *S. aucheri* Benth. is endemic to Turkey, and its dried leaves are commonly consumed locally as an herbal tea (Celep, pers. obs.).

Salvia aucheri was first collected from Cilicia (the eastern Mediterranean region of Turkey) by Gustave Coquebert de Montbret. Specimens of novelties for the Lamiaceae were generally stated to be at Montbret's herbarium at the Royal Botanic Gardens, Kew (Bentham, 1836: 37). Bentham subsequently described *S. aucheri* as a new species (1836: 38), noting the type as only "Hab. in Ciliciâ." One collection by de Montbret (*1534*) was found at Kew from the Turkish location of Cilicia, and this collection can be accepted as type material for *S. aucheri*. Because Bentham did not specify a particular collection, the name is lectotypified herein.

In contrast to *Salvia aucheri* from the eastern Mediterranean region, the type of *S. aucheri* var. *canescens* Boiss. & Heldr. was collected from Pinarbaşı in the central portion of the Mediterranean region of Turkey in 1845 and described by Boissier and Heldreich in 1879. In the Turkish account for *Salvia* by I. C. Hedge (1982), variety *canescens* was accepted as a local endemic within *S. aucheri*, similar to Boissier and Heldreich's 1879 treatment. Three other previously accepted varieties of the species (*S. aucheri* var. *amethystea* Emb. & Maire, *S. aucheri* var. *aurasiaca* Maire, and *S. aucheri* var. *mesatlantica* Maire) were later transferred to the North African species *S. blancoana* Webb & Heldr. ex Walp. (Figuerola, 1987; Figuerola et al., 1990).

Since 2005, the authors have carried out extensive field studies, collecting *Salvia aucheri* across its distributional range. These specimens were cross-checked with material housed at various herbaria (ANK, BM, E, G, GAZI, HUB, ISTE, and K). These field and herbarium studies demonstrate that the infraspecific taxa of *S. aucheri* are closely related, but differ at the subspecies level (Table 1). The taxa also differ in terms of their geographic distribution and phenology. *Salvia aucheri* and its subspecies *canescens* are both known from the Mediterranean region of Turkey, but according to Davis's grid system (1965), the former is distributed across the C5 and C6 grid squares while the latter is known only from the C4 grid square. Our field studies are also consistent with the *Flora of Turkey* (Hedge, 1982) and *Flora Orientalis* (Boissier, 1879).

Flowering of *Salvia aucheri* subsp. *canescens* occurs in June(–July); however, flowering of subspecies *aucheri* occurs for a longer interval, from June to August(–October) (Hedge, 1982; Celep, pers. obs.). Because of the morphological, chorological, and phenological differences, the taxa should be distinguished at the subspecies level.

1. Salvia aucheri Benth., Ann. Sci. Nat., Bot., ser. 2, 6: 38: 1836. TYPE: Turkey. "Hab. in Ciliciâ" [C5, Adana/Mersin, E Mediterranean region of Turkey], s.d. [1836], *G. Coquebert de Montbret 1534* (lectotype, designated here, K).

1a. Salvia aucheri subsp. **aucheri**.

Specimens examined. TURKEY. **C5: Adana:** Karsantı, *E. Yurdakul 41* (ANK); Pozantı, Gülek pass, *W. Siehe 665* (E); Gülek, *P. H. Davis 16476* (ANK); Pozantı, ca. Gülek Boğazı, *G. Akaydın & F. Celep 980* (ANK); Pozantı to

Table 1. Diagnostic morphological characters of *Salvia aucheri* subsp. *aucheri* and *S. aucheri* subsp. *canescens*.

	subsp. *aucheri*	subsp. *canescens*
Stem length (cm)	45–110	15–70
Leaves	simple or occasionally with one pair of lateral lobes	always simple
Leaf shape	oblong, elliptic to ovate-elliptic	linear-elliptic to elliptic
Leaf dimensions (cm)	(1.4–)4–13.5 × (1–)2–6	1–3.5(–4.5) × 0.4–1.6
Calyx length (mm)	6–10	4–6(–7)
Corolla color	whitish to light blue	pinkish to lilac
Corolla length (mm)	20–35(–40)	15–23

Akçatekir Kasabası, *F. Celep 1574* (ANK); Thyanitis, *W. Siehe 888* (K). **Mersin:** Çamlıyayla (Namrun), Pozantı to Çamlıyayla, Kadıncık valley, *F. Celep 1570* (ANK); Çamlıyayla, ca. Sarıkavak village, *Z. Aytaç 7026 et al.* (GAZI); Tekir, *A. Huber-Morath 1031* (ANK). **Niğde:** Ulukışla, Aksaray to Adana, *J. Darrah 230* (E); Çiftehan, Bolkar Mtn., Alihoca village, *F. Celep 1359*. **C6: Osmaniye:** Amanos Mtn., *Y. Akman 3029* (ANK); Gaziantep to Osmaniye 100 km, *N. & M. Tanker & E. Sezik* (ISTE 8302).

1b. Salvia aucheri subsp. **canescens** (Boiss. & Heldr.) Celep, Kahraman & Doğan, stat. nov. Basionym: *Salvia aucheri* var. *canescens* Boiss. & Heldr., Fl. Orient. 4: 593. 1875. *Salvia ermenekensis* Rech. f., Oesterr. Bot. Z. 95: 423. 1949. TYPE: Turkey. C4 Konya: "ad Bounarbachi [Pinarbasi] et in valle Djoksu [Göksu] inter Karaman et Ermenek," 25 June 1845, *Theodor von Heldreich 951* (holotype, G).

Specimens examined. TURKEY. **C4: Karaman:** 5 km S of Karaman, *J. Archibald 6789* (E); Ermenek, Balkusan (fr.) *P. H. Davis 16196* (ANK); betw. Ermenek & Mut, *E. Tuzlacı* (ISTE 45135); Ermenek, Kazancı village, *E. Tuzlacı* (ISTE 45221); Mut to Ermenek, 25 km before Ermenek, Çamlıca village to Damlaçal, *G. Akaydın & F. Celep 994* (ANK); Ermenek, Mut to Ermenek, 1.5 2 km before Ermenek, *G. Akaydın & F. Celep 999* (ANK); Mut to Ermenek, 39 km before Ermenek, *F. Celep 1245* (ANK); above Boyalı village, *A. Güner 12664* (GAZI); Sarıveliler to Ermenek 4 km, *Z. Aytaç 7580 et al.* (GAZI). **Içel:** 1 km NE of Gülnar, *A. Huber-Morath 9587* (E).

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A New Species of *Hagenbachia* (Anthericaceae) from Ecuador

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Abstract. A new species of *Hagenbachia* Nees & Mart. (Anthericaceae), *H. ecuadorensis* Cruden, is described from Ecuador. In addition to being geographically isolated from the other broad-leafed species in *Hagenbachia*, it has longer pedicels, filaments, and anthers, as well as qualitative differences in other traits.

Key words: Anthericaceae, Ecuador, *Hagenbachia*, IUCN Red List.

In 1987, I included broad-leafed specimens of *Hagenbachia* Nees & Mart. (Anthericaceae) from Ecuador in *H. panamensis* (Standl.) Cruden and noted that the anthers of one specimen were substantially longer than those of specimens from Central America (Cruden, 1987). The flowers of subsequent collections from Ecuador also had longer anthers. In addition, the filaments and pedicels were longer and differences in other traits were consistent with plants from Ecuador representing an undescribed species that is geographically disjunct from the other broad-leafed species, which occur in Central America and eastern Brazil, respectively (Cruden, 1987).

Hagenbachia ecuadorensis Cruden, sp. nov. TYPE: Ecuador. Napo: rd. Baeza–Tena, 10.5 km from Baeza, forested slopes E of Río Cosanga at suspension bridge, 1850 m, 13 Apr. 1992, *Øllgaard 99995* (holotype, AAU; isotype, QCA not seen). Figure 1.

Haec species *Hagenbachiae brasiliensi* Nees & Mart. et *H. panamensi* (Standl.) Cruden similis, sed ab eis pedicellis filamentis et antheris longioribus differt; etiam in Aequatoria crescit.

Perennial herbs from a short rhizome with thickened roots. Basal leaves 6 to 12(to 23), narrowly elliptic, (10–)13–48 × 7–29 mm. Scape 1(or 2), glabrous, 30–63 cm high, (1–)1.1–1.8(–2.4) times the length of most basal leaves, 0- to 3-branched; cauline leaves (1 or)2 or 3, lowest (0.7–)2–7 cm. Pedicels (4.5–)5.5–7.5 mm in flower, (6–)8–13 mm in fruit; flowers nutant, 2 to 4(or 5) per node. Tepals white with greenish tips, 4–7 mm; filaments slender, smooth, 2.5–3.2 mm, widened at the base; anthers 1.4–2 mm; ovaries 1–2.5 × (0.8–)1–2(–2.5) mm; styles persistent, straight, 3–3.9 mm; ovules (4 to)5 to 8(or 9) per carpel, (14 or 15)19 to 23 per ovary. Capsules ± globose, shallowly lobed, 3–5(–5.5) × 3–5 mm.

Distribution and habitat. *Hagenbachia ecuadorensis* is a species of steep slopes in wet, montane forest on the east side of the Andes in both primary and secondary forests. Its range extends ca. 450 km from Oyacachi (Napo Province) in northern Ecuador south to Parque Nacional Podocarpus (Zamora-Chinchipe Province) in southeastern Ecuador. Collections from the Cordillera del Cóndor (*Croat & Ferry 98902*, *Croat et al. 91061*) in northeastern Zamora-Chinchipe suggest that this species might also occur in adjacent Peru. Collections from northern Ecuador were made between 1800 and 2150 m and those from southern Ecuador between 917 and 1500 m.

IUCN Red List category. *Hagenbachia ecuadorensis* is evaluated here as Least Concern (LC) according to IUCN Red List criteria (IUCN, 2001). This assessment is based on the distributional range that extends ca. 450 km from north to south and a number of collections that have been made over that range in the past 20 years.

Phenology. Flowering specimens have been collected throughout the year; fruiting specimens have been collected in February, April, July, and August.

Etymology. *Hagenbachia ecuadorensis* is named for the country in which it occurs.

Discussion. Vegetatively this species is similar to the other broad-leafed species in *Hagenbachia* (Fig. 1; also see illustrations in Cruden, 1987; Cruden et al., 1991). However, the flowers of *H. ecuadorensis* are generally larger than those of *H. brasiliensis* Nees & Mart. and *H. panamensis* (Table 1). The flowers of *H. ecuadorensis* have somewhat longer tepals, longer anthers, longer filaments, and its ovaries contain more ovules. Likewise, the pedicels of the flowers and capsules of *H. ecuadorensis* are usually longer than those of *H. brasiliensis* and *H. panamensis* (Fig. 2). Furthermore, the capsules of *H. ecuadorensis* and *H. panamensis* are globose to subglobose (3–5[–5.5] × 3–5 mm) and those of *H. brasiliensis* are wider than

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Figure 1. Holotype of *Hagenbachia ecuadorensis* (*Øllgaard 99995*, AAU).

long (2–4 × [3.5–]4–6 mm). Also, in general, the scapes of *H. ecuadorensis* are taller relative to the length of the basal leaves ([1.1–]1.3–1.8[–2.4]) compared to those of *H. brasiliensis* (0.7–1.3[–2]) and *H. panamensis* (0.9–1.3).

Hagenbachia ecuadorensis is geographically disjunct from both *H. panamensis* and *H. brasiliensis*. The former occurs in Central America from Darién in southeastern Panama, quite close to the Colombian border, north through Costa Rica between 650 and

Table 1. Floral and capsule traits of the broad-leafed species of *Hagenbachia* and *Phalangium latifolium*.

	*H. brasiliensis**	*H. panamensis**	*H. ecuadorensis*	*P. latifolium*
Tepal length (mm)	2.5–4.5	4.5–5.5(−6)	4–7	7–10(−12)
Filament length (mm)	1.5–2.5	2–2.5	2.5–3.2	3.5–5.5(−6.5)
Anther length (mm)	0.4–0.8	0.9–1.5	1.4–2	1.5–2.5
Style length (mm)	NA	NA	3–3.9	(2–)3.5–7(−8)
Ovary length (mm)	ca. 1	0.8–1.2	1–2.5	1.5–2.5(−3.5)
Ovules per carpel	2	4 to 6	(4)5 to 8(9)	9 to 12
Capsule length (mm)	2–4	3–5	3–5(−5.5)	5–9.5(−10)
Pedicel of flowers (mm)	2.5–5.5	3–5	(4.5–)5.5–7.5	(5–)7–11(−12)
Pedicel of capsules (mm)	3–10	6.5–8	(6–)8–13	9–15

* From Cruden (1987).
NA — not available

1800 m where it occurs in rainforest, lower montane wet forest, and mid-elevation cloud forest. The latter is endemic to eastern Brazil where it occurs below 400 m in caatinga gallery forest, evergreen forest, and disturbed sites. In addition, *H. ecuadorensis* occurs at higher elevations than *H. brasiliensis* (917–2150 m vs. 40–300 m).

Hagenbachia ecuadorensis might be confused with *Phalangium latifolium* Kunth, which will be included in an undescribed genus (Cruden, in prep.). The tepals, pedicels of the flowers, and pedicels of the capsules of *P. latifolium* are generally longer (Table 1), the filaments are expanded in the upper half, and the capsules, which contain more ovules, are broadly oblong to oblong. *Hagenbachia* species differ in having straight filaments and capsules that are globose or wider than high. *Phalangium latifolium* is the only species in the undescribed genus that occurs in Ecuador. It occurs primarily on the Pacific slopes of the Andes (Azuay, Bolívar, Chimborazo, Cotopaxi, Imbabura, Loja, Pichincha, and Tungurahua provinces) and usually at higher elevations than *H. ecuadorensis* (1800–3900 m vs. 917–2150 m), which occurs on the Atlantic side of the Andes (Napo, Pastaza, Tungurahua, and Zamora-Chinchipe provinces). Both species were collected in Tungurahua, where *H. ecuadorensis* was collected between 1300 and 1800 m between Baños and Cashurco (*Hitchcock 21840*), and the two collections of *P. latifolium* were made between 1600 and 2200 m (Volcán Tungurahua above Baños, *Lehmann 7772* [K]) and 1860 m (Baños above Río Pastaza, *Ravenna 240* [K]). The Lehmann collection was undoubtedly made above 1850 m, as the elevation of Baños is

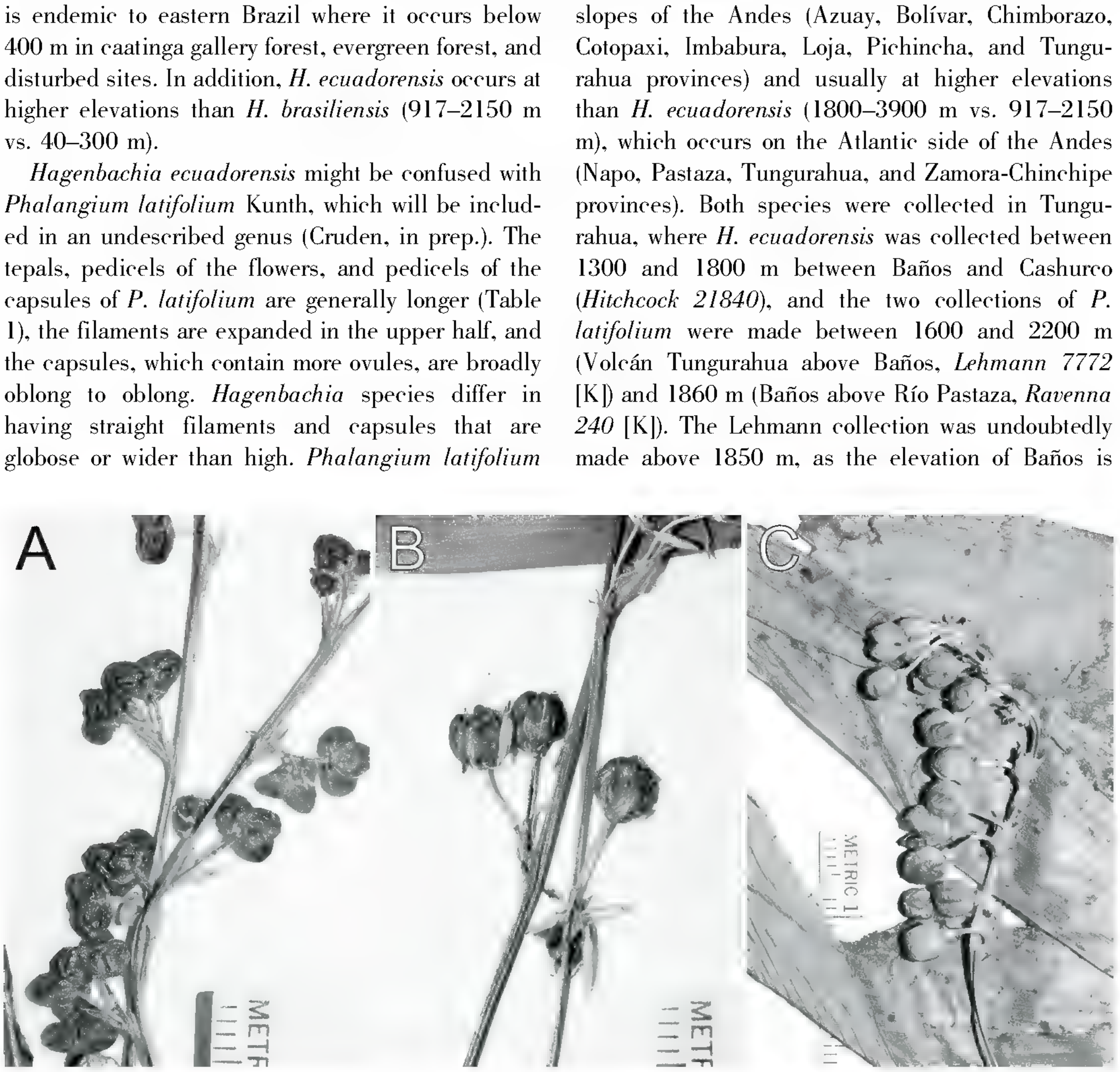

Figure 2. Pedicels and capsules of the broad-leafed species of *Hagenbachia*. —A. *H. brasiliensis*. Note the short pedicels and capsules that are wider than long (*Santos 2333*, U). —B. *H. ecuadorensis*. Note the long pedicels and subglobose capsules (holotype). —C. *H. panamensis*. Note the short, thick pedicels and subglobose capsules (*Croat 68911*, MICH).

given as 1826 m. Furthermore, *P. latifolium* generally occurs in habitats that are quite different from the wet montane forest in which *H. ecuadorensis* occurs, e.g., deciduous dry forest, subpáramo, and jalca, as well as a variety of disturbed habitats. Finally, neither *H. ecuadorensis* nor other species of *Hagenbachia* are likely to be confused with species in *Echeandia* Ortega, nearly all of which have yellow flowers, scaled filaments and/or connate anthers, and broadly oblong to oblong capsules (Cruden, 2009), or with other genera in Anthericaceae (see Conran, 1998; Cruden, 2009).

A specimen (*Mayor 329*, Z) from western Colombia ([Antioquia]: Don Elias near Angelópolis) composed of a scape and one basal leaf may represent another undescribed species. The collection site is on the western side of the Andes 300–500 m higher than those of *Hagenbachia ecuadorensis* (917–1850 [–2100] m vs. 2400 m). The collection site is much closer to the southeasternmost populations of *H. panamensis* in Panama (ca. 275 km vs. 780 km) but 700–800 m higher than the localities in Panama (650–1650 m). The specimen bears three fruits and an immature flower. The pedicels of the flowers are shorter than those of *H. ecuadorensis* (3.5–5 mm vs. [4.5–]5.5–7.5 mm long) and the pedicels of the capsules are longer than those of *H. brasiliensis* and *H. panamensis* (11–13.5 mm vs. 3–10 mm and 6.5–8 mm long, respectively). Also, the scape is ca. 1.4 times the length of the basal leaf, which is typical of *H. ecuadorensis* ([1–]1.1–1.8[–2.4] times the length of the longest basal leaf) and somewhat greater than those of most *H. brasiliensis* and *H. panamensis* (0.7–1.3[–2] and 0.9–1.3 times the length of the longest basal leaf, respectively). Finally, the basal leaf is narrower than most of those of the other species (11 mm vs. 8–24 mm, 7–29 mm, and [8–]13–28 mm wide for *H. brasiliensis*, *H. ecuadorensis*, and *H. panamensis*, respectively). Furthermore, the leaf is narrowed to ca. 3.5 mm wide 8–9 cm above the base and thus has the appearance of being petiolate. In the other broad-leafed species, leaves of equivalent length narrow 2–6 cm above the base and, in general, are broader (4–8 mm wide).

Paratypes. ECUADOR. **Napo:** Oyacachi, *Ståhl, Báez, Resl & Ternéus 3108* (AAU). **Pastaza:** Rd. Baños Puyo, Km 38, valley betw. El Cedro & Río Santa Maria, *Jørgensen & Lægaard 56455* (AAU, QCA not seen); 4.5 km W of Mera, Puyo Baños rd., *MacBryde 1542* (MO). **Tungurahua:** valley of Pastaza River, betw. Baños & Cashurco, *Hitchcock 21840* (US). **Zamora-Chinchipe:** Quebrada del León, affluent of Río Bombuscara, S of Zamora, edge of Parque Nac. Podocarpus, *Madsen & Ellemann 75114* (AAU, MO); 1100 m, *Madsen & Eriksen 85984* (AAU, QCA not seen); Quebrada de León, affluent of Río Bombuscara, S of Zamora, *Øllgaard, Madsen, Ellemann & Eriksen 90355* (AAU); rd. from Quime Ferry Crossing into Cordillera del Cóndor, 22 km above Río Zamora, 03°37′46″S, 78°26′17″W, *Croat, Hannon, Walhert & Jua 91061* (MO); rd. Tundaime to Condor Mirador, 19.4 km from main jct. in rd. near military post, 03°30′00″S, 78°26′08″W, *Croat & Ferry 98902* (MO); rd. from Zamora to Romerillos along Río Jambué, 13.3 km E of Río Bombuscaro Bridge in Zamora, 0.3 km E of Pituca (04°08′03″S, 78°56′37″), *Croat 91771* (MO); rd. betw. Namirez on Río Zamora to Nambija, 14.7 km E of Namirez, 5.9 km above San Carlos, 04°03′11″S, 78°47′48″W, *Croat 91421* (MO); rd. Loja–Zamara, Km 49, *L. Holm-Nielsen, S. Jeppesen, B. Løjtnant & B. Øllgaard 3800* (AAU, F, MO, NY, U).

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Novitates Agrostologicae, II. *Parodiolyra aratitiyopensis*, un Nuevo Bambú Herbáceo del Sur de la Guayana Venezolana

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RESUMEN. Se describe e ilustra *Parodiolyra aratitiyopensis* J. R. Grande (Poaceae, Bambusoideae, Olyreae, Olyrineae) con material proveniente del Cerro Aratitiyope, en el sur del estado Amazonas de Venezuela. Esta nueva entidad se distingue de *P. luetzelburgii* (Pilg.) Soderstr. & Zuloaga, la especie más afín, por presentar porte bajo, láminas linear-lanceoladas relativamente pequeñas con la base redondeada o truncada y los márgenes escabrosos (no fimbriados) a todo lo largo, inflorescencias relativamente menores y escabrosas sólo en los nudos, glumas de las espiguillas femeninas con pelos extendidos de hasta 1 mm de largo hacia su parte media y espiguillas masculinas linear-fusiformes. Se presenta una clave para diferenciar a las seis especies que han sido asignadas al género *Parodiolyra* Soderstr. & Zuloaga, y se discuten sus posibles relaciones en base a caracteres morfológicos.

ABSTRACT. *Parodiolyra aratitiyopensis* J. R. Grande (Poaceae, Bambusoideae, Olyreae, Olyrineae) is described and illustrated with material from Cerro Aratitiyope, in the southern part of Amazonas, Venezuela. This new taxon can be distinguished from *P. luetzelburgii* (Pilg.) Soderstr. & Zuloaga, the most similar species, by its smaller habit, smaller and linear-lanceolate leaf blades with a rounded or truncate base and scabrous margins (vs. fimbriate margins), smaller inflorescences that are scabrous only at the nodes, female spikelets with hairs to 1 mm long through the middle of the glumes, and linear-fusiform male spikelets. A key to differentiate the six species of the genus *Parodiolyra* Soderstr. & Zuloaga as presently understood is included, and a discussion of their possible relationships based on morphological characters is also offered.

Key words: Amazonas, Aratitiyope, Bambusoideae, IUCN Red List, *Parodiolyra*, Poaceae, Venezuela.

El Cerro Aratitiyope es una montaña granítica de forma columnar bastante aislada del resto de las tierras altas guayanesas, la cual alcanza los 1650 m.s.n.m. y se ubica en el sur del estado Amazonas de Venezuela (Huber, 1995a).

Producto de la reciente revisión del material de la subtribu Olyrineae depositado en el Herbario Nacional de Venezuela (VEN), y como parte de un proyecto que pretende estudiar la totalidad de sus miembros en dicho país, se presenta el siguiente adelanto, donde se describe como nueva para la ciencia la especie *Parodiolyra aratitiyopensis* J. R. Grande.

Parodiolyra aratitiyopensis J. R. Grande, sp. nov.

TIPO: Venezuela. Amazonas: Dept. Río Negro, Cerro Aratitiyope, ca. 70 km al SSW de Ocamo, con riachuelos afluentes al río Manipitiare, piedra ígnea, forest toward bluff, 2°10′N, 65°34′W, 990–1670 m.s.n.m., 24–28 Feb. 1984, *J. A. Steyermark, P. Berry & F. Delascio 130118* (holotipo, VEN 358959; isotipos, VEN 195204, MO no visto). Figura 1.

Haec species *Parodiolyrae luetzelbergii* (Pilg.) Soderst. & Zuloaga similis, sed ab ea habitu humiliore, lamina foliari lineari-lanceolata margine scabra, inflorescentia saepe minore internodiis glabris, spicula mascula lineari-fusiformi atque spiculae feminae glumis trichomatibus usque ad 1 mm longis in medio pubescentibus distinguitur.

Hierbas formando macollas pequeñas de 30–35 cm de alto; *culmos* herbáceos, erectos, medulosos, de hasta 1.8 mm diám., glabros, estramíneos, rara vez ramificados; *nudos* articulados, ligeramente engrosados, marrón claro, pilosos. *Vainas* conspicuamente nervadas, 3.2–6.4 cm, con nervios paralelos y prominentes, cubiertas de pelos extendidos, más densamente agrupados hacia el ápice donde además son estrigosas; *lígulas* escariosas, ca. 0.3 mm, consistentes de una lámina marrón clara con margen lacerado, glabras por el lado adaxial y cortamente adpreso-pilosas por el lado abaxial (los pelos no sobrepasan el margen); *pseudopecíolo* densamente piloso, marrón claro, ca. 1 mm; *láminas foliares* linear-lanceoladas, asimétricas hacia la base y el

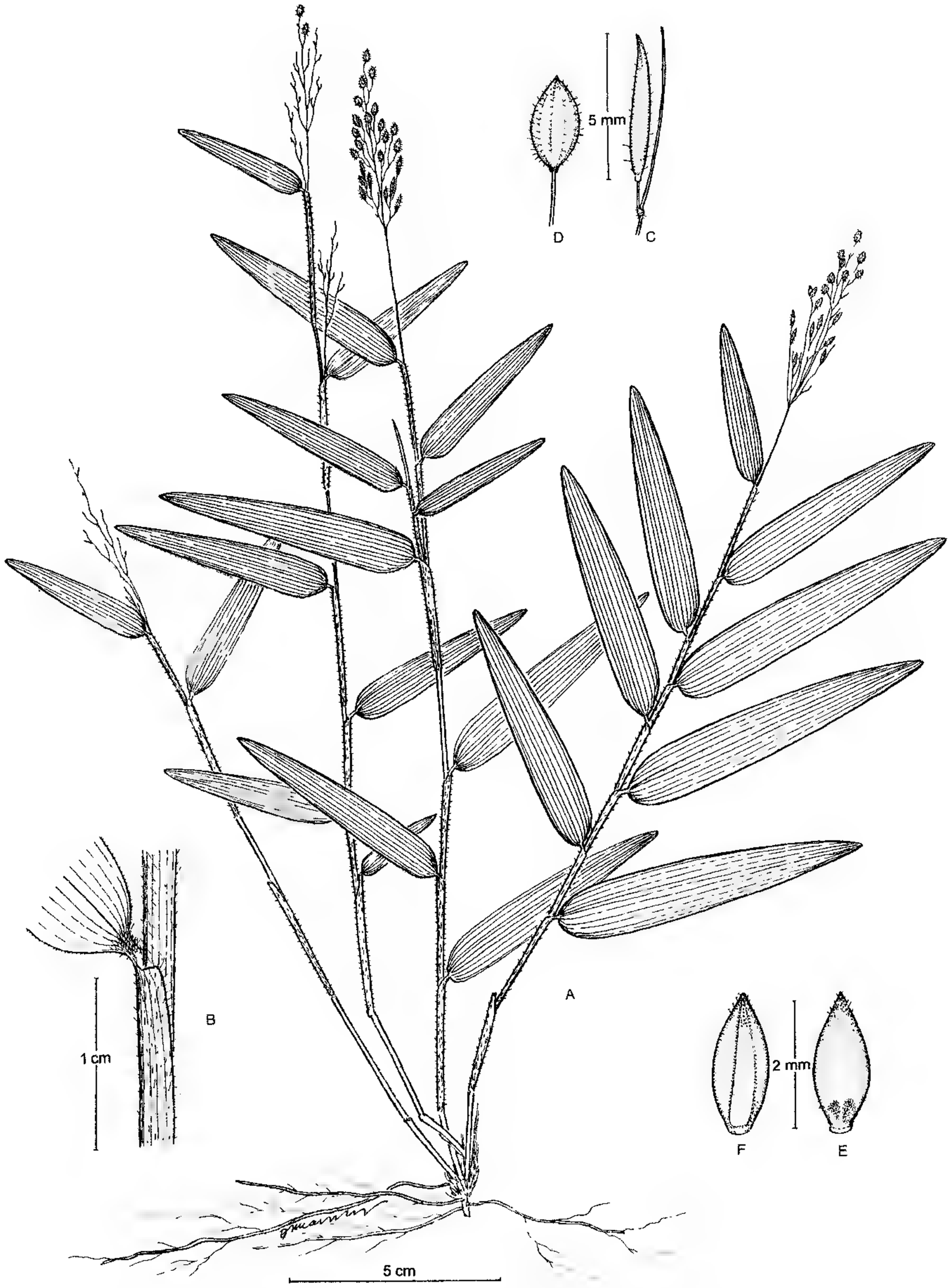

Figura 1. *Parodiolyra aratitiyopensis* J. R. Grande. —A. Hábito. —B. Zona de unión entre la vaina y la lámina. —C. Espiguilla masculina. —D. Espiguilla femenina. —E. Flósculo femenino, vista dorsal. —F. Flósculo femenino, vista ventral. A–F a partir del holotipo, *Steyermark et al. 130118* (VEN 358959).

ápice, agudas hacia el ápice, con la base redondeada ó truncada y los márgenes escabrosos a todo lo largo, con el mismo tipo de tricoma que se encuentra en el haz, 3–9.4 × 0.7–1.6 cm sin incluir al pseudopecíolo, haz estrigiloso, áspero al tacto, envés estrigoso-piloso, sólo ligeramente áspero, piloso en torno al pseudopecíolo. *Inflorescencias* paniculadas, piramidales, (1.1–1.6)3.1–6 × (0.2–0.3)0.7–5.6 cm, localizadas sobre el nudo superior o los dos nudos superiores (y entonces la que nace del nudo inferior considerablemente más pequeña), con las ramas basales portando espiguillas masculinas (a veces con una ó varias espiguillas femeninas en el ápice) y las ramas superiores portando espiguillas femeninas; *ejes de las inflorescencias* escabrosos y esparcidamente pilosos hacia los nudos, el resto glabro; *pedúnculos* inclusos, o exertos de la vaina hasta 3.2 cm. *Espiguillas masculinas* linear-fusiformes, 4.5–5 × 0.8–0.9 mm, de base obtusa y ápice acuminado; *glumas* glabras, reducidas a vestigios de base obtusa y ápice

truncado, ca. 0.2 mm; *lema y palea* escabrosas e hirsutas, con pelos de hasta 1 mm, reduciéndose en longitud tanto hacia el ápice como hacia la base; *espiguillas femeninas* elípticas hasta elíptico-obovadas, ca. 3 × 1.6 mm, de base obtusa y ápice brevemente apiculado, escabrosas, *glumas* escabrosas e hirsutas, con pelos extendidos de hasta 1 mm hacia la parte media, ausentes ó muy cortos hacia el ápice y la base, separadas por un entrenudo de ca. 0.3 mm, primera gluma 5-nervada y segunda gluma 7-nervada; *flósculo* ca. 2.5 × 1.2 mm, cartilaginoso, ovado, liso, brillante, cremoso, con el ápice ligeramente apiculado y con pelos papilosos marronuzcos, ápice de la palea con excavaciones circulares. Cariopsis no vista.

Distribución y hábitat. *Parodiolyra aratitiyopensis* se conoce solamente del Cerro Aratitiyope, en el estado Amazonas de Venezuela, entre 990 y 1670 m.s.n.m. (vs. 100–600 m.s.n.m. en *P. luetzelburgii* (Pilg.) Soderstr. & Zuloaga; Soderstrom & Zuloaga, 1989).

Categoría de la Lista Roja de UICN. *Parodiolyra aratitiyopensis* se conoce solamente de un área muy reducida (< 100 km²), cerca de la cima de una montaña pequeña (Cerro Aratitiyope). Según Rull et al. (2009), la flora de las montañas guayanesas corre riesgo de desaparecer o por lo menos verse severamente afectada como producto de un eventual ascenso en los pisos altitudinales de la vegetación a consecuencia del cambio climático. Esta especie, por lo tanto, podría ser considerada en Peligro Crítico (CR B1ab[iii]+2ab[iii]) según los criterios de la Unión Internacional para la Conservación de la Naturaleza (IUCN, 2001). En la única localidad conocida, sin embargo, no se conocen indicios de intervención antrópica, ni cambios recientes en la toposecuencia altitudinal (Huber, 1995b), por lo que sólo puede ser considerada Casi Amenzada (NT).

Etimología. El epíteto de esta nueva especie se establece para hacer referencia a la localidad tipo, de la cual es endémica. *Aratitiyopea* Steyerm. & P. E. Berry (Xyridaceae) es un género nombrado también por este cerro (Steyermark, 1984), pero ha sido colectado, además, en otras partes del Escudo Guayanés (incluyendo Venezuela, Colombia y Brasil; Kral, 2005).

Discusión. *Parodiolyra aratitiyopensis* es muy similar a *P. luetzelburgii*, bajo cuyo concepto fue incluida en *Flora of the Venezuelan Guayana* (Davidse et al., 2003). Las principales diferencias entre ambas especies se muestran en la Tabla 1. Adicionalmente, las espiguillas masculinas son 1/3 ó mas largas que las femeninas (vs. menos que un 1/3 más largas en *P. luetzelburgii*) y los nudos son escabrosos y esparcidamente pilosos (vs. escabrosos hasta híspidos en *P. luetzelburgii*).

Paratipos. VENEZUELA. **Amazonas:** Dpto. Río Negro, Cerro Aratitiyope, ca. 70 km SSW de Ocamo, con riachuelos afluente al río Manipitiare, forest along streamlet & quebrada to edge of N-facing escarpment, 2°10′N, 65°34′W, 990 1670 m, 24 28 Feb. 1984, *J. A. Steyermark, P. Berry & F. Delascio 130120* (MO no visto, VEN 195212, VEN 353989).

Incluyendo a esta nueva especie, *Parodiolyra* Soderstr. & Zuloaga agrupa seis especies neotropicales de afinidades oscuras, caracterizadas por la presencia de hábito herbáceo, espiguillas masculinas y femeninas de longitud similar, espiguillas femeninas con el entrenudo entre la primera y la segunda gluma conspicuamente desarrollado, subtendidas por un pedicelo filiforme, flósculo de la espiguilla femenina persistente (dispersándose junto con las glumas) y cariopsis con hilo de 1/2 a 3/4 (rara vez hasta 4/5) de su

Tabla 1. Principales diferencias entre *Parodiolyra aratitiyopensis* y *P. luetzelburgii*.

	P. luetzelburgii	*P. aratitiyopensis*
Hábito	erecto ó subescandente	erecto
Tamaño de la planta (m)	0.7–1.6	0.3–0.35
Forma de la lámina foliar	ovado-lanceolada	linear-lanceolada
Base de la lámina foliar	truncada, rara vez redondeada; escabrosa y fimbriada	redondeada ó truncada, escabrosa
Dimensiones de la lámina foliar (cm)	8–11 × 1.6–3.1	3–9.4 × 0.7–1.6
Dimensiones de la inflorescencia (cm)	5–8 × 4.5–8	(1.1–1.6)3.1–6 × (0.2–0.3)0.7–5.6
Entrenudos de la inflorescencia	escabrosos a híspidos	glabros
Espiguilla masculina	lanceolada	linear-fusiforme
Dimensiones de la espiguilla femenina (mm)	3–3.6 × 1.5–1.7	ca. 3 × 1.6
Pubescencia de las glumas de la espiguilla femenina	con pelos de hasta 0.5 mm hacia la base y el ápice	con pelos de hasta 1 mm hacia su parte media

longitud (Soderstrom & Zuloaga, 1989; Zuloaga & Davidse, 1999). Dentro de este género, cuya monofilia aún no ha sido probada, pueden reconocerse tres grupos de especies: *P. aratitiyopensis*, *P. luetzelburgii* y *P. ramosissima* (Trin.) Soderstr. & Zuloaga (el grupo típico, similar a *Raddiella* Swallen), *P. lateralis* (J. Presl ex Nees) Soderstr. & Zuloaga (con glumas adheridas al antecio al desarrollarse la cariopsis) y finalmente, *P. colombiensis* Davidse & Zuloaga y *P. micrantha* (Kunth) Davidse & Zuloaga (con flósculos femeninos completamente cubiertos de excavaciones circulares).

Clave de las Especies de *Parodiolyra*

1a. Espiguillas femeninas con el flósculo completamente cubierto de excavaciones circulares; espiguillas masculinas con lema escabrosa.
  2a. Espiguillas femeninas aristadas (aristas más largas que el cuerpo de la espiguilla), con el flósculo ovoide hasta subrotundo; plantas de Suramérica y las Islas Fiyi ..... *P. micrantha*
  2b. Espiguillas femeninas múticas, con el flósculo elíptico hasta fusiforme; plantas de la Amazonía Colombiana ..... *P. colombiensis*

1b. Espiguillas femeninas con flósculos lisos o con excavaciones circulares sólo hacia el ápice de la lema y la palea, rara vez a lo largo de los márgenes internos de la palea; espiguillas masculinas con lema hirsuta y escabrosa, sólo hirsuta, pilosa o glabra, pero nunca sólo escabrosa.
  3a. Espiguillas femeninas con glumas adheridas al flósculo al madurar, tornándose oscuras ..... *P. lateralis*
  3b. Espiguillas femeninas con las glumas libres al madurar, manteniéndose estamíneas.
    4a. Espiguillas femeninas 5–5.8 × 1.9–2.8 mm, con glumas escabrosas solamente; plantas del estado de Bahia (Brasil) ..... *P. ramosissima*
    4b. Espiguillas femeninas 3–3.6 × 1.5–1.7 mm, con glumas escabrosas y pilosas; plantas de la Amazonía, el Escudo Guayanés y/o el estado Táchira de Venezuela.
      5a. Plantas de 0.7–1.6 m de alto, erectas ó subescandentes; láminas foliares lanceoladas con la base escabrosa y fimbriada, 8–11 × 1.6–3.1 cm; glumas de las espiguillas femeninas con pelos inclinados, menores a 0.5 mm hacia el ápice y la base; plantas de la Amazonía, el Escudo Guayanés y el estado Táchira de Venezuela ..... *P. luetzelburgii*
      5b. Plantas de 0.3–0.35 m de alto, erectas; láminas foliares linear-lanceoladas con la base sólo escabrosa, 3–9.4 × 0.7–1.6 cm; glumas de las espiguillas femeninas con pelos extendidos de hasta 1 mm hacia su parte media; plantas del Cerro Aratitiyope (Guayana Venezolana) .... *P. aratitiyopensis*

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Aegiphila brenesii, a New Name for the Long-lost (Right Before Our Eyes) *Clerodendrum costaricense* (Lamiaceae)

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Abstract. *Aegiphila brenesii* Hammel (nom. et comb. nov.) is validated to replace *Clerodendrum costaricense* Standl., the epithet of which is preoccupied in *Aegiphila* Jacq. (Lamiaceae) by *A. costaricensis* Moldenke. The species in question has been known until now from only the two rather inadequate collections cited in the protologue. We find that it was misplaced to genus and that recent collections had been overlooked and included in a broad concept of *A. quararibeana* Rueda, a similar species of lower elevations.

Resumen. *Aegiphila brenesii* Hammel (nom. et comb. nov.) se publica para reubicar *Clerodendrum costaricense* Standl., dado que su epiteto ya se usa en *Aegiphila* Jacq. (Lamiaceae) para *A. costaricensis* Moldenke. Hasta ahora, esta especie se había conocido solamente de las dos recolecciones, bastantes inadecuadas, citadas en el protólogo. Encontramos que fue mal ubicada al género, y que recolecciones recientes habían pasado desapercebidas e incluidas en un concepto amplio de *A. quararibeana* Rueda, una especie parecida de elevaciones más bajas.

Key words: *Aegiphila*, *Clerodendrum*, Costa Rica, Lamiaceae, Verbenaceae.

Stimulated by a recent publication (Yuan et al., 2010) that realigns species of *Clerodendrum* L. occurring in the Mesoamerican region into two genera, in conjunction with our ongoing efforts to edit and revise the Verbenaceae (s.l.) treatment for the *Manual de Plantas de Costa Rica*, the first author made a trip in April 2010 to the type locality of the little-known *C. costaricense* Standl. [= *Volkameria costaricensis* (Standl.) Mabb. & Y.-W. Yuan] in search of new material to provide data missing from the description of that species.

In fact, because of its lianescent habit, much larger leaves, and montane habitat, this species differs markedly from the other native Costa Rican species of *Clerodendrum* (or *Volkameria* L.), and we had wondered years ago if it might belong to some other genus. The type collection (*Austin Smith H588*), with only a few flower buds and one or two partial flowers, was made in April 1938, near La Peña de Zarcero, Alajuela Province, at 1650 m elevation. An additional specimen cited in the protologue (Standley, 1938: 1002) from nearby Los Ángeles de San Ramón (*A. Brenes 6147*), also collected in April (1938), comprises a branch with just one attached inflorescence, with two flowers (calyx only). The April 2010 collecting trip to La Peña netted abundant material of the species (*B. Hammel & I. Pérez 25612*), with just one flower at anthesis, but plenty of others in various stages en route to mature fruits. The coincidence of those particular fruits on flowering material identical to the type of *C. costaricense* (and at its type locality) was unexpected, and immediately brought to mind *Aegiphila quararibeana* Rueda. Our recently completed review of the *A. quararibeana* collections at INB had resulted in the inclusion of the following note under the description of said species in the aforementioned *Manual de Plantas de Costa Rica* manuscript: "Material de las Cords. de Guanacaste, de Tilarán y Central, arriba de 700 m (p. ej., *Bello 4880*; CR, INB, MO) es practicamente glabro y tiene infls. más grandes que el resto del material. Posiblemente representa una entidad distinta." In fact, this entity, collected numerous times during the past 26 years, had long since been described (as *C. costaricense*), but from sparse material, hence the taxonomic confusion. Here we provide a new name, the necessary nomenclatural and taxonomic background demonstrating the need for a new name, and an expanded description.

Aegiphila brenesii Hammel, nom. et comb. nov. Replaced name: *Clerodendrum costaricense* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 18: 1002. 1938, non *Aegiphila costaricensis* Moldenke, 1933. *Volkameria costaricensis* (Standl.) Mabb. & Y.-W. Yuan, Taxon 59(1): 132. 2010. TYPE: Costa Rica. Alajuela: La Peña de Zarcero, 4 Apr. 1938, *Austin Smith H588* (holotype, F; isotypes, MO, NY).

Scandent shrub to 5 m, or high-climbing liana; plants dioecious; branchlets glabrous, yellowish tan,

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shiny. Leaves with the petiole 1–2 cm; blade 9–14 × 4.5–9 cm, ovate-elliptic, rounded to acute at the base, obtuse to acuminate at the apex, entire, glabrous on both surfaces, with abundant glandular dots (≤ 0.1 mm) on the abaxial surface (but without glandular disks), with 5 to 7 secondary nerves per side. Inflorescences axillary, lax, 1.5–3.5 × 1.5–5 cm (exclusive of the peduncle), the largest bracts foliar, 6–20(–25) × 1–5 mm, stipitate; peduncle 1.5–6 cm. Flowers 1 to 6, heterostylous, but functionally unisexual, with pedicel 1–9 mm; calyx 10–13 mm, tubular, with 4 narrowly triangular, apically rostellate lobes 1–1.5 mm (2 opposite sinuses often splitting to ca. 1/2 the tube as the corolla emerges, the other 2 splitting to 1/4 at most), indistinctly 4-ridged, strigulose to nearly glabrous, much-expanded in fruit and completely covering the developing fruit (but ultimately splitting open and leaving the mature fruit only partially covered); corolla cream-colored or greenish cream, glabrous (externally), ± trumpet-shaped, the tube ca. 13 mm, tomentose at point of stamen insertion, the lobes 4, ca. 10 mm; stamens 4, of equal length, inserted on the corolla tube about midway, the filaments tomentose at point of insertion, in staminate flowers ca. 10 mm, well-exserted from the tube but not beyond the lobes, the anthers ca. 3 mm, in pistillate flowers the filaments ca. 4 mm, the anthers (lacking pollen) ca. 2 mm, barely 1/2 exserted from the narrow part of the corolla tube; style in staminate flowers ca. 4 mm, hidden within the corolla tube, in pistillate flowers ca. 24 mm (including the 2 branches, ca. 8 mm), well-exserted from the corolla tube. Fruits brown, 2.5–3 cm, ± globose, 1/3–1/2 covered by the irregularly 4-lobed calyx.

Distribution, habitat, and phenology. *Aegiphila brenesii* is endemic to Costa Rica in pluvial, cloud, and oak forest at 1100–1700+ m elevation, on the Caribbean slope and near the Continental Divide of the Cordilleras de Guanacaste (Volcán Tenorio), de Tilarán, and Central, and on the Pacific slope of the Cordillera Central (Volcán Poás). The species has been collected in flower during March and April, and with fruits in March, April, August, and September. Considerable confusion has been propagated with regard to the elevation of *E. Bello & E. Cruz 4880*; even though the original field notes indicate an elevation of 1200 m, the labels distributed indicate "700 m." We have chosen to respect the original notes as more likely to be accurate.

IUCN Red List category. Although *Aegiphila brenesii* does occur in at least one private reserve (Reserva Monteverde), it is not known from any national park and is restricted to a rather narrow elevational range. At the type locality, only very small, isolated patches of forest remain on the steepest slopes and highest peaks, surrounded by extensive pastures and other agricultural lands. Given increasing population pressure and global warming, *A. brenesii* must certainly be classified as Vulnerable (VU), according to IUCN Red List Criteria (IUCN, 2001).

Etymology. The epithet honors Alberto M. Brenes (1870–1948), apparently the first botanist to collect the species. His collections, numbering over 20,000, mostly from the region around his hometown of San Ramón (and encompassing the type locality of *Aegiphila brenesii*), will forever be important to Costa Rican floristics.

Relationships and history. *Aegiphila* Jacq. species, in contrast to those of *Clerodendrum* and *Volkameria*, are heterostylous but probably dioecious (see below). *Aegiphila brenesii* is closely related to the more widespread *A. quararibeana*, under which name the majority of material of it has been filed over the past 16 years. It shares with that species unusually large flowers and fruits for the genus, as well as the lianescent habit. It differs by its larger inflorescences ([4–]6–8 cm [including the peduncle] vs. 2–3.5 cm) with larger bracts (6–20[–25] × 1–5 mm vs. ca. 5 × 0.5–2 mm) and its glossy and glabrous (vs. opaque and granulose-puberulent) branchlets. *Aegiphila quararibeana* occurs at lower elevations in Costa Rica (0–800 m) and on both slopes, attaining 800 m elevation in the Acosta region of the Pacific slope. By virtue of their large flowers and fruits, both of these species are similar to the lowland Amazonian *A. macrantha* Ducke, with which *A. quararibeana* has already been compared (Rueda, 1994). Although the peduncles of *A. macrantha* (ca. 1–6.5 cm) can be as long as those of *A. brenesii* (1.5–6 cm), the inflorescence proper is much more congested (the flowers and bracts sessile to subsessile) and even more conspicuously bracteate, the bracts closely approximate on the abbreviated inflorescence axes with the largest ones 6–15(–25) × 3–11 mm. The branchlets of *A. macrantha* are granulose-puberulent, like those of *A. quararibeana*, not glabrous like those of *A. brenesii*.

How and why the two original specimens of *Clerodendrum costaricense* were never associated with *Aegiphila* until now is probably due, in part, to the paucity of flowers on the original material, and the fact that the few available flowers are young and staminate, obscuring the similarity of the species to *A. quararibeana*, known for its unusually large fruits. That something was amiss might have been suspected

from a contradiction in Standley's original description, where the phrase "flowers four-parted" is quoted from Austin Smith's label notes, even while *Clerodendrum*, in the same publication, is described as having the calyx 5-merous. Likewise, Rueda (1993) characterized *Clerodendrum* as having the calyx and corolla 5-parted, but included the 4-merous *C. costaricense* without comment. One collection of what is now realized to be *A. brenesii* from Monteverde with abundant staminate flowers (*Bello & Cruz 4880*) might reasonably have been compared to *C. costaricense*, except for the fact that it combines detached fruits or fruit pieces (certainly from a different individual) with staminate leafy branches; no one ever hesitated in associating it with *A. quararibeana*, nor expected such fruits on *C. costaricense*. Furthermore, we became aware of the heterostylous but apparently dioecious nature of most species of *Aegiphila* only recently, while examining specimens during the editing of the *Manual* manuscript, and were reminded of the hermaphroditic flowers (with didynamous stamens) of *Clerodendrum* (and *Volkameria*) on reading Yuan et al. (2010). The literature is noncommital or contradictory with regard to the sexuality of *Aegiphila*. For example, Moldenke (1973: 102) stated that the flowers of *Aegiphila* are "hermaphroditic but usually conspicuously declinous [sic]," whereas Croat (1978), explicitly acknowledging Moldenke's observation, nevertheless considered the flowers to be simply heterostylous. We have seen no specimens with exserted stamens that also have even immature fruits, and any flowers on fruiting specimens have always included stamens that lack pollen. In any case, as pointed out by Yuan et al. (2010), *Aegiphila*, *Clerodendrum*, and *Volkameria* are closely related taxa; they have been confused and differently circumscribed in the past, as they will most certainly continue to be. But for now, the long-lost *Clerodendrum costaricense* has been rediscovered at its type locality and found among recent collections, right before our eyes, properly filed under *Aegiphila*.

Additional specimens examined. COSTA RICA. **Alajuela:** Cantón de Alajuela, Hotel Posada Volcán Poás, 13 Mar. 2003 (bud), *R. Kriebel 2910* (INB); Cantón de Guatuso, Parque Nac. Volcán Tenorio, Alto Masís, 20 Sep. 2001 (fr.), *J. L. Chaves, G. Rodríguez, I. López & A. López 1315* (INB); [Cantón de San Ramón], Los Angeles y La Paz, 30 Apr. 1928 (fl.), *A. Brenes 6147* (F); Río La Balsa, 30 Aug. 1991 (fr.), *E. Bello 4006* (INB); Cantón de Zarcero, La Peña, 17 Abr. 2010 (fl., fr.), *B. Hammel & I. Pérez 25612* (CR, INB, MO). **Guanacaste:** Cantón de Tilarán, Río Caño Negro, 11 Mar. 1993 (fl., fr.), *E. Bello & E. Cruz 4880* (CR, INB, MO). **Puntarenas:** Cantón de Puntarenas, Reserva Biol. Monteverde, 21 Aug. 1984 (fr.), *A. Gentry & W. Haber w/Class 84-3 48713* (MO).

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Validation of the Genus Name *Darcyanthus* and Its Sole Species, *Darcyanthus spruceanus* (Solanaceae)

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Abstract. The generic name *Darcyanthus* Hunz. (Solanaceae) was not validly published. The present paper provides validation both for the generic name and for the single included species, *D. spruceanus* (Hunz.) Hunz.

Key words: *Darcya*, *Darcyanthus*, Solanaceae.

In the process of identifying some Fosberg collections from Loreto Department, Peru, I came upon a collection of what is called in current literature *Darcyanthus spruceanus* (Hunz.) Hunz. I consulted the International Plant Names Index (IPNI) and discovered that the name was not validly published because the precise place of publication was not properly cited in various works by Hunziker. The name is herein validated with the precise pages of publication now given.

Hunziker (2000a) erected the genus *Darcya* Hunz. (although hom. illeg. superfl.) to honor the manifold contributions of William D'Arcy (1931–1999) to our understanding of the Solanaceae; the generic concept included but a single species, *Physalis spruceana* Hunz. The generic description complies with nomenclatural rules, and the combination in *Physalis* L. is likewise consonant with the rules. However, Hunziker soon learned of the existence of *Darcya* B. L. Turner & C. C. Cowan (Scrophulariaceae). Hunziker (2000b: 167) promptly published a correction, which is brief enough to quote in its entirety (with correction of a few typographical errors that have no nomenclatural significance):

"*Darcyanthus* nom. nov. substitutes [for] *Darcya* (Solanaceae)."

"Due to a regrettable oversight, the name *Darcya* B. L. Turner & C. Cowan (Scrophulariaceae, Phytologia 74(3): 268. 1993) was ignored by me, when I published *Darcya* Hunziker (Solanaceae, Bol. Soc. Argent. Bot. 35(1–2): 163–169. 2000). Thanks to the good will of colleagues, I have been alerted about my mistake, and I hasten to propose *Darcyanthus* nom. nov. (Solanaceae), to replace the illegitimate name; in consequence, the specific correct name should be *Darcyanthus spruceanus* (Hunziker) Hunziker comb. nov."

The substitute name *Darcyanthus* Hunz. was not validly published because Hunziker failed to cite the specific page where *Darcya* Hunz. appeared (p. 167), instead citing a range of pages. This violates Article 33.4, especially Note 1, of the *International Code of Botanical Nomenclature* (McNeill et al., 2006). The combination *Darcyanthus spruceanus* (Hunz.) Hunz. is not validly published because Hunziker failed to cite the place of publication of the basionym, in addition to the fact that any combination involving an invalid generic name is itself invalid (Article 43.1).

In 2001, Hunziker's *Genera Solanacearum* appeared (Hunziker, 2001). Therein (p. 249) appears language that might have served to validate the generic name *Darcyanthus*. However, once again, Hunziker failed to cite a specific page number for the original publication of his illegitimate *Darcya*; rather, he cited the same page range as in the brief article quoted above. (It may be noted in passing that this two-sentence paper was not included in the bibliography of Hunziker by Anton [2002].)

The combination *Brachistus spruceanus* (Hunz.) D'Arcy is cited in Hunziker (2001: 250) in an indirect way, but the name is not included in the index. In any case, Hunziker's new system for the entire family would place *Brachistus* Miers in a different subtribe from *Darcyanthus*, though both are placed in the same tribe, Solaneae. It seems likely that future workers in the family will adopt much of Hunziker's work; the necessity to validate Hunziker's names therefore arises, with retention of the original authorship, as allowed by the Code, Article 46.2, Ex. 9, Note 1 (McNeill et al., 2006).

Darcyanthus Hunz., nom. nov. Replaced name: *Darcya* Hunz., Bol. Soc. Argent. Bot. 35(1–2): 167. 2000, non *Darcya* B. L. Turner & C. C. Cowan, Phytologia 74(3): 268. 1993. TYPE: *Darcya spruceana* (Hunz.) Hunz., nom. inval.

Darcyanthus spruceanus (Hunz.) Hunz., comb. nov. Basionym: *Physalis spruceana* Hunz., Kurtziana 1: 208. 1961. *Brachistus spruceanus* (Hunz.) D'Arcy, Monogr. Syst. Bot. Missouri Bot. Gard.

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45: 1259. 1993. TYPE: Peru. Loreto: 24 Dec. 1931, *Ynes Mexia 6340* (holotype, NY; isotypes, BM, G, GH, K, UC).

Thus far, the genus is monotypic. According to Hunziker (2001), the species is known from the eastern rainforests of Peru (Amazonas, Ayacucho, Huánuco, Junín, Loreto, Madre de Dios, and San Martín departments), as well as Bolivia (La Paz and Pando departments), at elevations of 150–1100 m. A very detailed illustration (Hunziker, 2000a: 168; repeated as fig. 88, Hunziker, 2001: 251) complements a much simpler one in *Kurtziana* (Hunziker, 1961: 209).

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Three New Costa Rican Species of *Calathea* (Marantaceae) from Montane Wet Forests

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Abstract. Three species of *Calathea* G. Mey. in *Calathea* sect. *Calathea* (Marantaceae) are described as new from montane wet forest habitats in Costa Rica: *C. recurvata* H. Kenn., *C. tarrazuensis* H. Kenn., and *C. verruculosa* H. Kenn. These are found in montane wet, montane rainforest, or cloud forest habitats at mid to higher elevations from 800 to 1500 m. All three taxa are endemic to Costa Rica. *Calathea recurvata* differs from related distichous-bracted species by the close vein spacing (30 to 35 lateral veins per 3 cm) of the leaf, pale whitish green to yellowish green bracts with recurved apical margins, claviculate bracteoles, yellow or pink corolla lobes, and yellow or pink-purple staminodes. *Calathea verruculosa* is distinguished by the shiny dark green ovate leaf, verruculose petioles and peduncles, stiff lime-green bracts with apically recurved margins, claviculate bracteoles, and yellow corolla and staminodes. *Calathea tarrazuensis* is distinguished by the narrowly ovate-elliptic leaf with length:width ratios of 2.13–4.8:1 and an acuminate-attenuate apex, the glabrous pulvinus, relatively long peduncles (44–111 cm), the elliptic olive-green bracts with the uppermost bract incoiled on itself not subtending flowers, the apically flattened, slightly thickened bracteoles, and the cream-white flowers.

Resumen. Tres especies de *Calathea* G. Mey. dentro de *Calathea* sect. *Calathea* (Marantaceae) se describen como nuevas, las cuales crecen en bosque húmedo, pluvial o nublado, a elevaciones medias desde 800 hasta 1500 m. Las tres especies son endémicas de Costa Rica. Entre las especies con inflorescencias dístico-bracteadas, *C. recurvata* se distingue por la corta distancia entre los nervios laterales de la hoja (30 hasta 35 nervios laterales por cada 3 cm), las brácteas blanquecino-verdosas a amarillo-verdoso pálidas con los márgenes apicales recurvados, las bractéolas claviculadas, los lóbulos de la corola amarillo claros o rosados y los estaminodios amarillos o purpúreo-rosados. *Calathea verruculosa* se distingue por las láminas foliares ovadas, verde oscuro brillantes, los pecíolos y pedúnculos verruculosos, las brácteas cartáceas, verde-lima con los márgenes apicales recurvados, las bractéolas claviculadas, y la corola y los estaminodios amarillos. *Calathea tarrazuensis* se distingue por las hojas ovado-elípticas angostas, 2.13–4.8 veces tan largas como anchas, con ápice acuminado-atenuado, el pulvínulo glabro, pedúnculos largos (44–111 cm), las brácteas elípticas de color verde aceituna con la ultima bráctea enrollada y sin flores, las bractéolas aplanadas apicalmente y poco gruesas, y las flores blanco-crema.

Key words: *Calathea*, *Calathea* sect. *Calathea*, Costa Rica, IUCN Red List, Marantaceae, montane wet forest.

Since Standley's treatment of Marantaceae for the *Flora of Costa Rica* (Standley, 1937), there has been a substantial increase in the number of species known from Costa Rica. Standley listed a total of 28 species, of which 26 are currently recognized as distinct, 14 in the genus *Calathea* G. Mey. Standley noted nine species as endemic, six in *Calathea*. Currently, only two of the nine are still considered endemic. By 1978, there was a total of 46 species recognized, an increase of ca. 77% for the family (Kennedy, 1978) with 13 noted as endemic. The percent increase recorded for the genus *Calathea* was greater, ca. 120%, with 31 species. Of the 20 species added since Standley (1937), five were new records and 15 were previously undescribed species. With increased collecting in Costa Rica, the number of reported species is now more than double what Standley reported. This is partly due to improvement of access through new or improved roads, but is largely due to the concerted collecting by the botanists at the Instituto de Biodiversidad to inventory the flora. In the Marantaceae treatment in *Manual de Plantas de Costa Rica* (Kennedy, 2003), 56 species (an increase of 115% from Standley's flora) were reported for the family, of which 41 (ca. 190% increase) were in the genus *Calathea*. Of the 41 species, two were undescribed, but mentioned as Calathea sp. A and Calathea sp. B in the *Manual* treatment, and are described herein. Currently, 59 species (18 endemic) are recognized for the family, of

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which 44 are in *Calathea* (12 endemic). Of the three additional *Calathea* species, two are endemic to Costa Rica (one described herein, and one to be described), while the third is a new species to be described, found in Panama and Costa Rica. Interestingly, six of the 12 endemic species in the genus are in *Calathea* sect. *Calathea*. Only one, *C. platystachya* Standl. & L. O. Williams, is a lowland species; the other five occur in montane wet or cloud forest habitats, above 800 m. This suggests a burst of speciation in *Calathea* sect. *Calathea* in montane habitats in Costa Rica.

Petersen (1890: 89) treated *Calathea* sect. *Calathea* as "Sect. VII. Distichae." Schumann (1902) called it *Calathea* subg. *Eucalathea* and characterized its plants as having distichous bracts and laterally complanate inflorescences. The new species described here clearly exhibit these characters. In general, *Calathea* sect. *Calathea* is characterized by the presence of several basal leaves and a single cauline leaf subtending one to several distichous-bracted, complanate inflorescences, open flowers, and usually yellow capsules with deep blue seeds bearing white arils. Naturally there is variation and not all species exhibit all of these characters. Specimens of several species with distichous bracts have been previously determined as *C. crotalifera* S. Watson, a common and widespread species, as specimens are much more similar in general aspect than are the living plants. The distinctive bract color, recurved bract margins, and bracteole characters of the new species are less obvious in pressed specimens. The new species have bracts that are pale whitish green to pale yellowish green, chartreuse to lime-green or olive-green, but not the bright yellow to yellow-orange of *C. crotalifera*.

1. **Calathea recurvata** H. Kenn., sp. nov. TYPE: Costa Rica. San José: Cantón de Vasquez del Coronado, below Bajo La Hondura, Río La Hondura drainage, trail below finca, steep slopes, 1100 m, 10°04′N, 83°59′W, 20 Sep. 1972, *H. Kennedy 1680* (holotype, CR; isotypes, INB, K, MO, U not seen, UBC). Figure 1.

Haec species a congeneris bracteis distichis praeditis foliorum venis lateralibus crebris (30 ad 35 per 3 cm), bracteis sat grandibus pallide albido- vel flavido-viridibus marginibus apicalibus recurvatis, bracteolis claviculatis, lobis corollinis flavis roseolisve atque staminodiis flavis roseopurpureisve distinguitur.

Herb, 1.8–3.5 m high, bearing 2 to 5 basal leaves and 1 cauline leaf above a stem internode of 50–120 cm; stem green, node yellowish, node and uppermost portion of stem appressed tomentose; cataphylls narrowly ovate, apiculate, innermost cataphyll 50–110 cm. Leaf blade coriaceous, ovate, 53–92 × 30–60 cm (length:width ratios 1.4–1.95:1), apex rounded with a slightly eccentric acumen, base obtuse to rounded, lateral veins 30 to 35 per 3 cm (measured at midpoint of each side of blade); leaf blade shiny deep green adaxially, glabrous, often the acumen minutely appressed tomentose, midrib yellow-green, glabrous in basal 1/2 to 2/3, sparsely minutely tomentose (×14 magnification) apically; leaf surface dull olive-green abaxially with marginal band tinged purple, sparsely minutely tomentose, basal portion and toward midrib subglabrous with hairs concentrated along major veins, hairs denser and more evenly dispersed toward margin and apically, hairs 0.2–0.3 mm arising from swollen basal cushion of cells, midrib yellow-green, appressed tomentose throughout apically, hairs ca. 0.5 mm, toward base subglabrous or tomentose only along sides; pulvinus elliptic in cross section, olive-green, glabrous, 10–24 cm; petiole green, faintly scabrous, 40–120 cm; leaf sheath not auriculate, green, densely pubescent along margin; sheath of cauline leaves 16–43 cm, in basal leaves, 70–110 cm. Inflorescences 1 to 4 per shoot, first one terminal, subsequent ones axial, in axil of subtending leaf, strongly complanate, rectangular, 15–28 × 6–8.5 cm; peduncle green, densely appressed tomentose in upper 0.5–1 cm, subglabrous below, 25.5–55(–65) cm; bracts 16 to 35, distichous, imbricate, chartaceous, transverse broadly obovate, conduplicate, apex retuse, apical margins recurved, 3.2–4 × 4–5.5 cm, lowermost bract occasionally noticeably separated from upper ones, each subtending up to 5 or more flower pairs, bracts pale whitish green to pale yellow-green, outer surface faintly hispid to touch, sparsely minutely tomentose (×16 magnification) and recurved along the margin and at apex, the rest subglabrous to glabrous, inner surface dull, glabrous; inflorescence rachis often exposed in dried material, densely appressed tomentose, hairs 0.5–0.7 mm; bicarinate prophyll membranous, broadly elliptic, apex truncate to shallowly retuse, translucent light yellow-green, minutely appressed tomentose on sides and adjacent surface of carina, central portion glabrous, 2.1–2.2 × 1.3–1.6 cm, 0.8–0.9 cm wide from carina to carina; secondary bract membranous, elliptic, apex obtuse to emarginate, light yellow-green, appressed pilose at apex and apical margins, glabrous basally, 1.6–2 × 0.8–1.5 cm; bracteoles 1 per flower pair, indurate claviculate, medial, white basally, upper claviculate portion yellow to pale yellow-green, 1.8–2.4 cm. Sepals channeled, narrowly obovate, obtuse to 90°, cupped apically, white to pale cream-colored basally, yellow-green at apex, glabrous or very sparsely

Figure 1. *Calathea recurvata* H. Kenn. —A. Habit. —B. Inflorescence. —C. Flowers and claviculate bracteoles photographed against the adaxial leaf surface. —D. Flower, face view. Photos A and B of *Kennedy 1558* (MO); photos C and D of *Kennedy & DeVris 3773* (CR). Photos by the author.

minutely pubescent at apex, 23–27 × 4–6 mm; corolla ca. 43–44 mm; tube pale yellow or pale pink, sparsely appressed pilose, ca. 24 mm; staminal tube 8–10 mm; corolla lobes subequal, elliptic to obovate, obtuse to 90°, margins inrolled, appearing acute, pale cream-colored to light yellow basally, yellow-green at apex or pale pink, appressed pilose, 16–22 × 5–6 mm; outer staminode obovate, retuse, yellow or deep pink throughout or pink to peach centrally with the marginal portion purple to dark purple, ca. 17 × 16 mm; callous staminode oblong, apex petaloid, unequally bilobed, pale yellowish throughout or pink

to peach-colored basally with apical petaloid portion purplish or dark purplish pink, ca. 22 × 7 mm; cucullate staminode light yellow throughout or pinkish purple basally with hood and trigger purple to dark purple, ca. 8 mm; stamen with lateral pink-purple, petaloid appendage; anther yellow, 3.5–4 mm; style and stigma pale yellowish or pink-purple; ovary white, glabrous, ca. 3 × 2 mm. Capsule smooth, obovoid, cream-colored or pink-purple, glabrous, ca. 13 × 8 mm, crowned by an enlarged, persistent, pale green calyx to 27 mm; seeds usually 3 per capsule, trigonous, dark blue, ca. 6 × 4.5 × 3 mm, bearing a white aril to 4 mm.

Distribution and phenology. *Calathea recurvata* occurs at mid to upper elevations for Marantaceae, collected from 800 to 1300 m in montane rainforest and cloud forest habitats. Flowering is noted to extend from July through January.

IUCN Red List category. Conservation for *Calathea recurvata* must be considered as Least Concern (LC) according to IUCN Red List criteria (IUCN, 2001), because it is known from many collections and has been found in both San José and Cartago provinces.

Etymology. The specific epithet, *recurvata*, refers to the recurved apical margins of the bracts.

Discussion. *Calathea recurvata* belongs to *Calathea* sect. *Calathea*, having the characteristic habit of several basal leaves and a cauline leaf subtending the one to several, distichous-bracted inflorescences. This new species is distinguished from other related species of *Calathea* with distichous bracts by the relatively large (3.2–4 × 4–5.5 cm), pale whitish to yellowish green bracts with recurved apical margins, the yellow or pink-purple petals and staminodes, and the claviculate bracteoles. It is closely related to two undescribed Panamanian species from similar cloud forest habitats in the bordering provinces of Chiriquí and Bocas del Toro, which will be described in a subsequent paper. Although the recurved bract margin is quite distinctive in the field, it may or may not be obvious in pressed material, but generally at least some bracts exhibit this character. *Calathea recurvata*, *H. Kennedy 1558* (BM, CR, DUKE, INB, MO, US), is the species referred to as "*C.* sp. A." in *Manual de Plantas de Costa Rica* (Kennedy, 2003: 654).

Paratypes. COSTA RICA. **Cartago:** forest beside Río Gato, 29 Dec. 1973, *R. Lent 3725* (CR, F); near Selva on hillside above Río Taus, 09°45′N, 83°45′W, 2 Aug. 1972, *J. Taylor & C. Taylor 11471* (BRIT). **San José:** Cantón de Vasquez de Coronado, below La Palma, Río Claro (upper Río La Hondura), along trail to Guapiles, 10°03′N, 83°58′W, 1 Jan. 1967, *W. C. Burger 4133* (BM, CR); below La Palma, NE of San Jerónimo, Río Claro valley (Río La Hondura drainage), 10°03′N, 83°58′W, 19 Nov. 1969, *W. C. Burger, R. Baker & J. Utley 6250* (CR); 23 Oct. 1975, *W. C. Burger, R. Baker & J. Utley 9388* (AAU, CR, US); Parque Nac. Braulio Carillo, La Palma, Río Bajo La Hondura, 23 Jan. 1983, *N. Garwood, M. Gibby, R. J. Hampshire & C. J. Humphries 371* (BM, CR, MO); Parque Nac. Braulio Carrillo, Cuenca del Sarapiquí, Quebrada Sanguijuela, 15 km E del Tunel Zurquí, 10°09′28″N, 83°57′49″W, 18 July 1997, *B. Hammel, G. Swick & S. Troyo 21004* (INB, MO); below Bajo La Hondura, Río La Hondura drainage, trail below the finca, 10°04′N, 83°59′W, 6 Sep. 1972, *H. Kennedy 1558* (BM, CR, DUKE, INB, MO, US); Bajo La Hondura, 10°04′N, 83°59′W, 8 Sep. 1976, *H. Kennedy & P. DeVris 3773* (CR, INB, PMA, UCR); Parque Nac. Braulio Carillo, ca. 10°04′N, 84°00′W, 28 Aug. 1990, *H. Kennedy 4585* (CR, INB, MO); Parque Nac. Braulio Carrillo, trail from La Ventana to Río La Hondura, 10°04′20″N, 84°59′00″W, 4 Sep. 1990, *H. Kennedy & J. Solomon 4600* (CR, INB, MEXU, MO, UCR); Parque Nac. Braulio Carillo, La Montura, along ridge, 25–30 July 1982, *C. Todzia 1958* (CR).

2. Calathea verruculosa H. Kenn., sp. nov. TYPE: Costa Rica. Cartago: Cantón de Turrialba, 6 km W of La Suiza on rd. to Pacayitas, small, wet forest remnant, 1200 m, 09°52′20″N, 84°35′10″W, 8 Sep. 1990, *H. Kennedy & J. Solomon 4646* (holotype, CR; isotype, MO). Figure 2.

Haec species a congeneris bracteis distichis praeditis petiolis pedunculisque verruculosis, lamina foliari nitida atroviridi late ovata, bracteis rigidis flavovirentibus marginibus apicaliter recurvatis, bracteolis claviculatis atque corolla staminodiisque flavis distinguitur.

Caulescent herb, 0.9–1.9 m high, bearing 1 to 3(to 5) basal leaves and (0)1(2) cauline leaves above a stem internode of 27–140 cm; cataphylls coriaceous, narrowly ovate, apiculate, dark green tinged with purple or purple, verruculose and hispid, innermost cataphyll 14.5–37 cm; stem dark green or tinged reddish brown, verruculose, though less pronounced than on petiole, scabrid. Leaf blade stiff, chartaceous, broadly ovate, 20–55 × 12–32 cm (length:width ratios 1.5–1.9:1), apex obtuse with pronounced slightly eccentric acumen, base broadly obtuse to truncate; leaf blade shiny deep green adaxially, glabrous except acumen and adjacent apical margins tomentose, midrib olive-green, tomentose, more densely so toward apex; leaf surface with a less shiny sheen abaxially, deep grayish green to olive-green, glabrous except minutely tomentose at apex and along the very margin, midrib yellow-green, minutely appressed tomentose; pulvinus elliptic in cross section, nearly 2× as deep as wide, olive-green, glabrous or minutely tomentose along front, nearly confluent, (2.1–)3–8(–9.5) cm; petiole dark green or

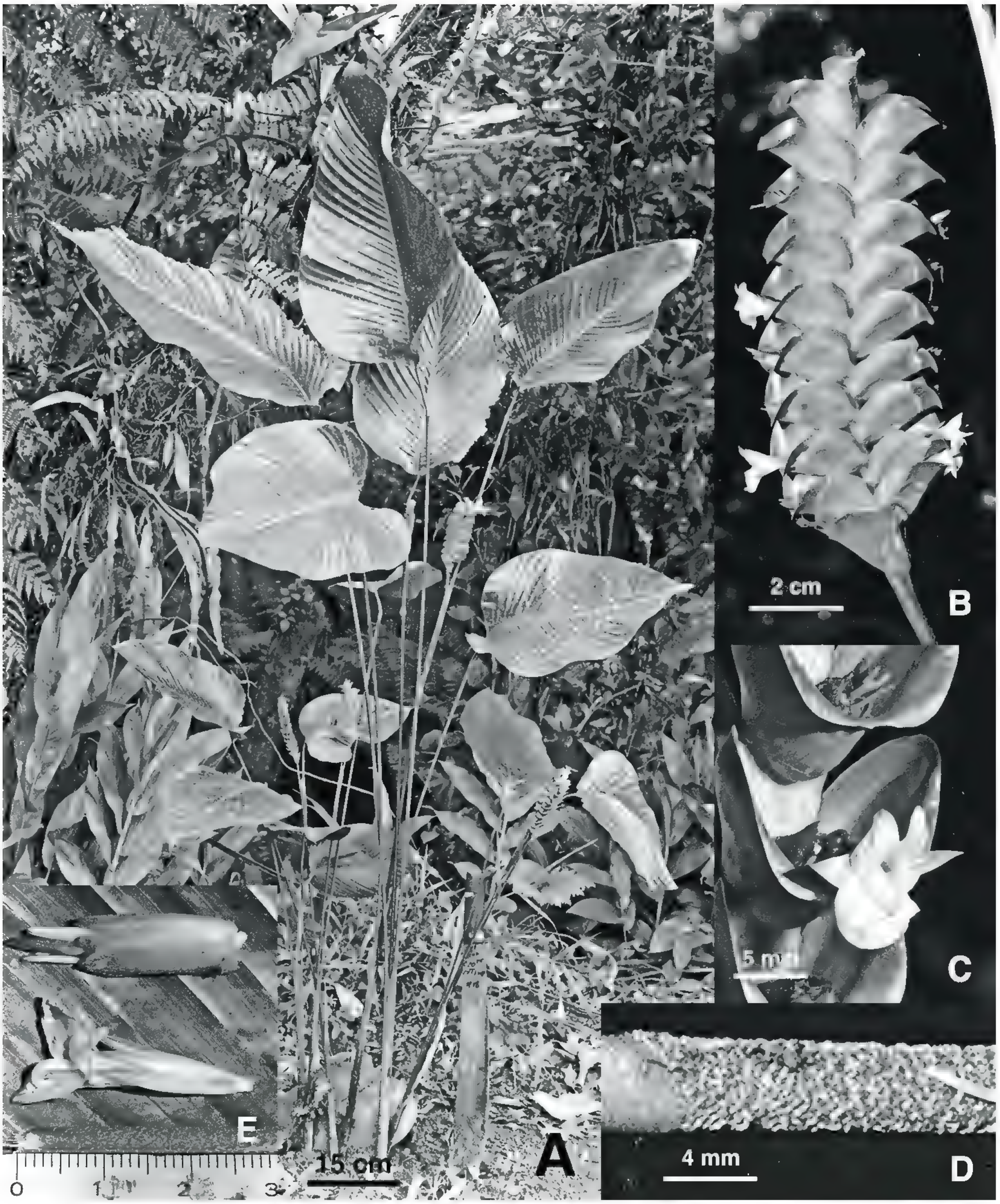

Figure 2. *Calathea verruculosa* H. Kenn. —A. Habit. —B. Inflorescence. —C. Flower, face view. —D. Base of pulvinus and upper portion of verruculose petiole. —E. Flower (lower), bicarinate prophyll with secondary bract and claviculate bracteoles (above) photographed against the adaxial leaf surface. Photos A and D of the type, *Kennedy & Solomon 4646* (CR, MO); photos B, C, and E of a plant cultivated at Wilson Botanical Garden from Tuis, *Kennedy 3737* (INB). Photos by the author.

tinged purple apically, verruculose, junction to pulvinus densely appressed tomentose, hairs to 0.6 mm, minutely tomentose where verruculose as well, hairs much denser on subtending leaf petiole, 5–10 cm in cauline leaves, 18–95 cm in basal leaves; leaf sheath not auriculate, dark olive-green to dark green, often tinged purple at apex and along margin in cauline leaves, dark green streaked purple in basal leaves, center back verruculose and scabrid, hairs on minute excrescences, wings finely grooved with indented lines, hispid, margin ciliate, hairs to 1 mm, longer toward margin and base, 10–16.5 cm in

cauline leaves, 25–62 cm in basal leaves; base of leaf sheath yellow-green, appressed tomentose, hairs to 1 mm long. Inflorescences 1 to 2 per shoot, terminal, strongly complanate, rectangular, (6.5–)8.5–13 × 3.5–4.2 cm; peduncle dark green, verruculose basally, apical 1 cm only slightly roughened, scabrid, (4.5–)8.5–31 cm; bracts 11 to 26, distichous, imbricate, stiff, chartaceous, transverse elliptic, conduplicate, apex emarginate, apical margins recurved, 2–2.9 × 2.5–3.4 cm; each bract subtending 5 or more flower pairs; outer surface of bracts chartreuse to lime-green, often a somewhat deeper green toward the margin, sparsely minutely tomentose at apex and along margins, much more so apically, the central portion subglabrous to glabrous at base; inner surface shiny, glabrous; bicarinate prophyll membranous, elliptic, apex rounded, translucent yellow-green, sides and carina tomentose, center back glabrous, 1.5–2 × 0.9–1.25 cm, 0.5–0.7 cm wide from carina to carina; secondary bract membranous, elliptic, apex emarginate, pale yellow-green, minutely tomentose apically, glabrous toward base, 1.5–1.9 × 0.9–1.2 cm; bracteoles 1(rarely 2) per flower pair, indurate claviculate, medial, thickened apical portion yellow, white basally, glabrous, (1.6–)2–2.3 cm. Sepals thin herbaceous, narrowly elliptic, acute to obtuse, basal 1/2 translucent white, light green apically, darker at apex, glabrous to subglabrous with sparse minute hairs apically, ca. 0.2 mm long, 16–19 × 3.5–4 mm; corolla tube pale yellow, sparsely pilose, 12–18 mm; corolla lobes subequal, elliptic, acute to 90°, pale yellow to pale yellow-green apically, pilose, hairs ca. 0.5 mm, more dense toward apex, 9–12 × 3–4 mm; staminodes yellow; outer staminode broadly elliptic, apex rounded, ca. 8 × 7 mm; callous staminode rectangular, apex bilobed, lobes petaloid, the rest callous, ca. 10 × 4 mm; cucullate staminode ca. 4.5 × 3.5 mm; stamen with lateral petaloid appendage extending to apex of the anther; anther light yellow, ca. 2.5 mm; style and stigma light yellow; ovary smooth, cream-colored, glabrous, ca. 2 × 1 mm. Capsule obovoid, light yellow, glabrous, ca. 12 mm high, crowned by a persistent calyx; seeds trigonous, rugose on outer surface, blue, ca. 6 × 4.5 × 3 mm, bearing a white aril.

Distribution and phenology. *Calathea verruculosa* occurs at mid-elevations, 800–1300 m, in premontane wet to cloud forest habitat, in moderate to dense shade often near streams. Flowering is noted primarily during the rainy season, from June to September.

IUCN Red List category. Conservation for *Calathea verruculosa* should be considered as Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001), because it is known only from a few collections. The area where it is found is not readily accessible except just along the road, but certainly further exploration of the area is merited.

Etymology. The specific epithet, *verruculosa*, refers to the warty, verruculose petioles that are a highly distinctive feature of this species.

Discussion. *Calathea verruculosa* belongs to *Calathea* sect. *Calathea*. This new species is readily distinguished from other distichous-bracted species by the stiff, chartreuse to lime-green bracts with reflexed apical margins; yellow flowers; readily visible claviculate bracteoles; chartaceous, shiny, deep green, broadly ovate leaf blades; and, most notably, the warty, verruculose petioles and peduncles. Even in sterile plants, this last character is so distinctive that the plant can be readily identified. It is most similar to an undescribed species from Panama that will be described in a subsequent paper. One paratype for *C. verruculosa*, *Kennedy & Hammel 5171* (CR, INB, UBC), was referred to as "*C.* sp. B" in *Manual de Plantas de Costa Rica* (Kennedy, 2003: 654).

Paratypes. COSTA RICA. **Cartago:** Cantón de Turrialba, Tayutic, Vereh. Grande de Oro, Cuenca superiore, 09°48′05″N, 83°29′30″W, 29 July 1995, *G. Herrera & A. Cascante 8203* (CR); Cantón de Turrialba, 6 km N of La Suiza on rd. to Pacayitas, 09°52′15″N, 83°35′25″W, 9 Oct. 1990, *H. Kennedy & B. Hammel 5167* (INB, MO); Cantón de Turrialba, ca. 10 km N of La Suiza on rd. to Pacayitas, 09°52′15″N, 83°35′25″W, 9 Oct. 1997, *H. Kennedy & B. Hammel 5171* (CR, INB, UBC); Cantón de Turrialba, rd. betw. Moravia & Grande de Oro, E of La Suiza, 09°49′20.1″N, 83°26′49.1″W, 13 July 1992, *W. J. Kress, C. S. Roesel, B. Bowditch, M. Anderson & T. Prinzie 92-3502* (INB, MO, US).

Cultivated plant. COSTA RICA. **Cartago:** near Tuis, cultivated at Wilson Botanical Garden, Las Cruces, 6 km S of San Vito de Java, vouchered 3 Sep. 1976 as *H. Kennedy 3737* (INB).

3. Calathea tarrazuensis H. Kenn., sp. nov. TYPE: Costa Rica. San José: Cantón de Tarrazú, 7.5 km from fork in rd. for Naranjita versus Quepos/Esquipales, in forest on slope along rd., 1084 m, 09°33′51″N, 84°03′06″W, 14 July 2005, *H. Kennedy, B. Hammel, I. Pérez & F. Morales 5995* (holotype, INB; isotypes, CR, MEXU, MO, UCR, USJ). Figure 3.

Haec species inter congeneros bracteis distichis praeditis quoad foliorum formam colorem texturamque etiam bracteas pubescentes *Calatheae lasiostachyae* Donn. Sm. maxime affinis, sed ab ea inflorescentia proportione latiore brevior-

Figure 3. *Calathea tarrazuensis* H. Kenn. —A. Habit. —B. Inflorescence. —C. Flower photographed against leaf. —D. Capsule photographed against leaf. Photos A and B of the type, *Kennedy et al. 5995* (INB, MO); photos C and D of *Kennedy et al. 5115* (INB). Photos by the author.

eque, bracteis paucioribus semper longiorubus quam latioribus atque floribus cremeo-albidis distinguitur.

Rhizomatous herb, 1.6–3.9 m high, bearing 4 to 7 basal leaves and 1 cauline leaf above a 0.6–3 m stem internode. Leaf blade coriaceous, narrowly ovate-elliptic, (48–)74–106 × (10–)26–41 cm, subtending leaf 52–94 × 12–39 cm (length:width ratios [2.13–] 3.11–4.12[–4.8]:1), the lowermost basal leaf much smaller than subsequent leaves, apex acuminate attenuate, base obtuse to rounded, shortly attenuate; leaf blade deep green adaxially, glabrous but sparse tomentose in apical 5 mm of apex, midrib olive-green, sparse tomentose along margins in basal portion becoming more densely tomentose, but only in center apically, subglabrous at apex; leaf surface dull abaxially, matte green with slight yellowish cast, sparsely appressed tomentose apically, becoming sparsely hispid in basal 3/4–4/5, excrescences, ca. 0.1 mm, felt more than seen, midrib yellow-green

basally grading to yellow near apex, appressed tomentose throughout apically, hairs only along sides in basal portion; pulvinus olive-green, glabrous, (6.2–)10.5–20 cm; petiole olive-green shading to yellowish, almost caramel-colored toward base, subglabrous to minutely scabrid just above sheath, 32–104 cm long in subtending cauline leaf, (39–)104–186(–236) cm long in others; leaf sheath not auriculate, caramel-colored on back, wings yellow-green to brownish yellow-green toward base, densely appressed tomentose along margins and at base, hairs to 1 mm, central portion minutely tuberculate; sheath of subtending cauline leaf 20–38 cm, others (27–)62–113 cm. Inflorescences 1 to 5 per shoot, the first terminal, subsequent ones lateral, borne in the axil of the subtending leaf, strongly complanate, rectangular, 9.2–13 × (3.2–)5.5–8 cm, width substantially less (to 2.3 cm) in young, nonflowering inflorescences; peduncle dark olive-green, appressed tomentose, very densely so at base, hairs more dense on abaxial side, 44–97(–111) cm; bracts 8 to 18, distichous, imbricate, coriaceous, elliptic, conduplicate, apex retuse, often dying back at apex, 3.8–4.5 × 2.8–3.5 cm, each bract subtending up to 4 or more flower pairs, outer surface of bracts deep olive-green, except light brown where dying back at apex, sparsely minutely appressed tomentose centrally, densely tomentose with longer hairs (ca. 1 mm) along margins and apex, inner surface deep olive-green, appressed tomentose centrally, just below sinus and on apical lobes, glabrous basally; rachis covered by bases of bracts, not visible in live or dried material; bicarinate prophyll firm centrally, thickened along the base of the carina, somewhat membranous toward margin, narrowly ovate-elliptic, apex ca. 90°, translucent light chartreuse, dying back at apex becoming orangish tan, sides and adjacent carina appressed tomentose, apical 1/5 of center back and carina tomentose, glabrous basally, 3.5–3.9 × 1.2–1.3 cm, 0.5–0.8 cm wide from carina to carina; secondary bract membranous but with 2 slightly thickened narrow vertical bands ca. 1/3 of the way in from margin, ovate, apex obtuse, somewhat shredded in age, light chartreuse, dying back at apex, becoming orangish tan, densely appressed tomentose in apical half and along margins, central basal portion glabrous, 3.3–3.5 × 1.2–1.4 cm; bracteoles 1 per flower pair, medial, dorsiventrally flattened, not quite indurate, basal portion membranous, slightly thicker near apex, linear, apex acute, white basally, very tip tinged yellow-orange, glabrous, 1.5–1.8 × 0.15–0.2 cm. Sepals membranous, narrowly elliptic-triangular, acute to 90°, white basally, apex tinged faint yellowish, glabrous or sparsely pilose in upper 2/3 but always with tuft of hairs at very apex (×14 magnification), hairs to 0.5 mm, 17–20 × 2–4 mm; corolla tube white, sparsely appressed pilose, 26–28 mm; corolla lobes subequal, elliptic, obtuse, white tinged faintly yellow at apex, appressed pilose, 12–15 × 4–5 mm; outer staminode broadly elliptic, clawed at base, rounded, white, faint yellow to yellow-green, apically, ca. 8 × 7 mm; callous staminode spatulate with one side wider than the other, apex off-center, obtuse, white, faintly tinged yellow-green apically, 11–13 × ca. 4.5 mm; cucullate staminode white, 5–6 × ca. 3 mm; stamen with narrow lateral petaloid appendage; anther yellow, 2.5–3 mm; style and stigma white; ovary smooth, white, glabrous, ca. 3 × 1.5 mm. Capsule obovoid, cream-colored, glabrous, 11–12.5 × 7–8 mm, crowned by a persistent calyx; seeds usually 3 per capsule, trigonous, blue, ca. 8.5 × 3.5 × 3.5 mm, bearing a white aril.

Distribution and phenology. *Calathea tarrazuensis* occurs at mid-elevations, from 845 to ca. 1500 m, in montane wet to cloud forest habitats, often in more open areas or near forest margins. Flowering is noted to be nearly year-round, from May to February, as this species occurs in areas of high rainfall.

IUCN Red List category. Conservation for *Calathea tarrazuensis* should be considered as Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001), because it is only known from a restricted area and from only a few collections. The region where *C. tarrazuensis* is found is considerably less accessible than that of *C. verruculosa*, as the unpaved roads are virtually impassable in the rainy season; this makes collecting difficult, but at the same time lessens the threat.

Etymology. The specific epithet, *tarrazuensis*, refers to its restricted distribution, mainly in Cantón de Tarrazú, San José Province.

Discussion. *Calathea tarrazuensis* belongs to *Calathea* sect. *Calathea*. This species is distinguished by the narrowly ovate-elliptic leaf with length:width ratios of 2.13–4.8:1 and an acuminate-attenuate apex, the glabrous pulvinus, the long peduncles (44–97[–111] cm), the bracts longer than wide and deep olive-green dying back apically in early flowering, the uppermost bract incoiled on itself not subtending flowers, the single bracteole that is apically flattened but only slightly thickened, and the cream-white flowers. The new species is most closely related to *C. lasiostachya* Donn. Sm., sharing a similar leaf shape, color, and texture, with both taxa having pubescent bracts, though these hairs are longer and much more readily visible in *C.*

lasiostachya. *Calathea tarrazuensis* is distinguished from *C. lasiostachya* by the proportionately wider and shorter inflorescences (9.2–13 × [3.2–]5.5–8 cm vs. 8–25 × 5–7.5 cm) with fewer bracts (8 to 18 vs. 18 to 38), and the cream-white versus yellow to pink or purplish flowers. The bracts are always longer than wide in *C. tarrazuensis* but are more variable in *C. lasiostachya*, whereas in many populations the bract width is equal to or greater than the length. In the field, the two species are mainly separated by altitude, with *C. lasiostachya* mainly found in the lowlands but recorded up to 1000 m and *C. tarrazuensis* found from 850 to 1500 m. In the key to species in the *Manual de Plantas de Costa Rica* (Kennedy, 2003: 632), *C. tarrazuensis* would key out under lead 11′ due to its inflorescence to 8 cm wide and to its not having bracts with the waxy white, pruinose coating. There is a conflict with the if-then clause because the inflorescence is longer than 7.5 cm and is not more than 2.5 times as long as wide; however, it would key out with *C. retroflexa* H. Kenn. because they share the relatively shorter and wider inflorescence shape and the bracts that are always longer than wide. *Calathea tarrazuensis* differs from *C. retroflexa* in its uniformly green adaxial leaf surface versus the strongly contrasting whitish green to pale green area along the midrib and glabrous in *C. retroflexa*, the leaf length:width ratio greater than 2.13 (usually greater than 3) versus 2 or less, the straight versus reflexed inflorescence rachis, and the appressed tomentose versus glabrous bracts.

Paratypes. COSTA RICA. **Puntarenas:** Cantón de Parrita, along rd. from San Marcos to Fila Chonta, near Cerro Curú, 09°35′10″N, 84°08′55″W, 27 Feb. 1999, *H. Kennedy, B. Hammel & F. Morales 5115* (INB, UCR). **San José:** Cantón de Tarrazú, ca. 12 km SW of San Marcos, on rd. to Quepos, 09°34′26″N, 83°04′20″W, 14 July 2005, *H. Kennedy, B. Hammel & I. Pérez 6042* (INB, PMA); Cantón de Tarrazú, ca. 7 km from rd. fork for Naranjita versus Quepos/Esquipales, 09°33′51″N, 84°03′06″W, 15 July 2005, *H. Kennedy, B. Hammel & I. Pérez 6044* (INB); Cantón de Tarrazú, Nápoles, Cerro Toro, 09°34′20″N, 84°03′52″W, 1 May 1996, *J. Sánchez & G. Vargas 671* (CR); Cantón de Tarrazú, Fila Bustamante, San Isidro de Tarrazú, en borde de camino, 09°31′N, 84°04′W, 27 Aug. 1987, *N. Zamora, I. Chacón & G. Herrera 1425* (CR, F, MO).

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Calathea matudae and *C. sousandradeana*, New Species of Marantaceae from Mexico and Northern Central America

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Abstract. Two species of Marantaceae, *Calathea matudae* H. Kenn. & Ganders from Chiapas, Mexico, to Honduras, and *C. sousandradeana* H. Kenn. & Ganders from Veracruz and Oaxaca, Mexico, are described as new for inclusion in *Flora Mesoamericana*. *Calathea matudae* differs from *C. atropurpurea* Matuda in lacking reduced basal inflorescences, the bract acumen that is shorter and acute at the tip, the bracts that consistently dry brown, and the cross veins between the lateral veins of the leaves that are farther apart (15 to 20 per 5 mm vs. 23 to 30 per 5 mm in *C. atropurpurea*). *Calathea sousandradeana* differs from *C. matudae* and *C. atropurpurea* by the smaller, glabrous bracts with obtuse to rounded margins in the upper ones. A key is provided to the Mexican species in *Calathea* sect. *Breviscapus* Benth.

Resumen. Dos especies de Marantaceae, *Calathea matudae* H. Kenn. & Ganders de Chiapas en México hasta Honduras, y *C. sousandradeana* H. Kenn. & Ganders de Veracruz y Oaxaca en México, se describen como nuevas para su inclusión en la *Flora Mesoamericana*. *Calathea matudae* es diferente de *C. atropurpurea* Matuda en no tener inflorescencias basales reducidas, el acumen de la bráctea mas corto, agudo en el ápice, las brácteas secan consistentemente de color café, y los nervios transversales entre los nervios laterales de la hoja son más separados (15 hasta 20 por cada 5 mm vs. 23 hasta 30 por cada 5 mm en *C. atropurpurea*). *Calathea sousandradeana* es diferente de *C. matuda* y *C. atropurpurea* en las brácteas más pequeñas y glabras con el margen apical obtuso hasta redondo en los brácteas superiores. Se proporciona una clave para las especies mexicanas de *Calathea* sect. *Breviscapus* Benth.

Key words: *Calathea*, Chiapas, Honduras, IUCN Red List, Marantaceae, Mexico, Oaxaca, Veracruz.

As part of the Flora Mesoamericana project, the Mexican species of *Calathea* G. Mey. (Marantaceae) were examined to resolve the taxonomic problem concerning those taxa with basal leaves, spirally arranged green bracts, and yellow flowers (in *Calathea* sect. *Breviscapus* Benth.).

Two species in *Calathea* sect. *Breviscapus* were described by Matuda from Mexico. In 1950, he described *C. ovandensis* Matuda from Chiapas. In a later paper (Matuda, 1956), he described a second species, *C. atropurpurea* Matuda, from Estado de México. *Calathea coccinea* Standl. & Steyerm. (Standley & Steyermark, 1944) from southern Mexico to Guatemala and, more recently, *C. misantlensis* Lascur. (Lascurain, 1996) from Veracruz are likewise in *Calathea* sect. *Breviscapus*, but are readily distinguished by their red flowers, red bracts, and bract morphology.

Collections of the green-bracted plants from the Mexican states of Oaxaca, Veracruz, and Chiapas, Guatemala, and Honduras have been variously identified as either *Calathea ovandensis*, *C. atropurpurea*, or affined species. These plants appear quite similar in overall morphology, especially as dried specimens. They all have ovoid to ellipsoid, relatively small (2.5–6.5 cm) inflorescences, spiral green bracts, and claviculate bracteoles. Additionally, these taxa are all deciduous, often first producing an inflorescence on a leafless shoot, and the leaves are relatively thin textured and pubescent throughout on the adaxial surface. This last character is not only quite distinctive of this collected group, but is quite rare within *Calathea* overall (though it is shared with *C. coccinea* and *C. misantlensis*). Flower color is variously noted as yellow or cream-white, or the corollas may be tinged or streaked with purple or lilac, or entirely purple.

When all the material extending from Sinaloa, Mexico, to Honduras was laid out in a geographical sequence, a distinctive pattern of variation emerged: three different taxa were apparent. Mexican populations from Sinaloa to Guerrero have generally larger

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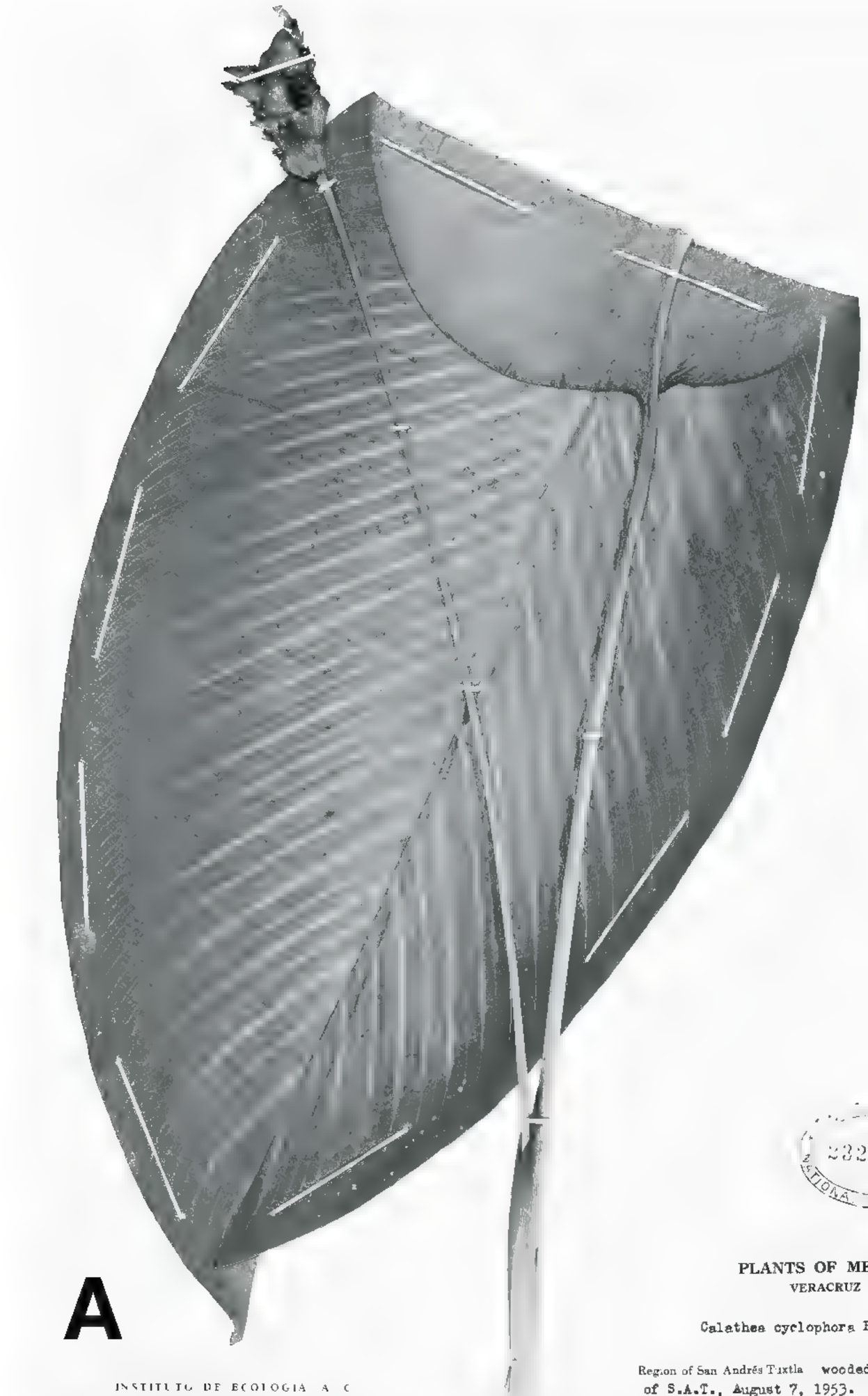
inflorescences with attenuate, apically recurved, pubescent bracts. They often have one to five (to 10) reduced basal inflorescences in the axils of cataphylls (see Fig. 1D). These inflorescences are irregularly ovoid, 1–1.6 cm long, with three to five unequal bracts, on peduncles 2–5 cm long, while the terminal inflorescences are ellipsoid, 2.5–4.5 × 1–1.5(–2.5) cm, with (10)15 to 25 bracts, on peduncles 20–40 cm long (McVaugh, 1989). These northernmost populations are consistent with Matuda's type of *Calathea atropurpurea*. Populations from Oaxaca and Veracruz constitute a distinct species, contrasting sharply with their smaller inflorescences with obtuse to rounded, nonrecurved, glabrous bracts. This species, *C. sousandradeana* H. Kenn. & Ganders, described herein, was included under the name *C. ovandensis*, with a drawing of the inflorescence, by Lascurain (1995: 15–18, fig. 1j) in the *Flora de Veracruz*. The specimens from Chiapas south to Honduras more closely resemble *C. atropurpurea*, having generally larger inflorescences with recurved acuminate, tomentose bracts, and they were frequently annotated as such, by myself and others, especially for Honduran material. However, this material constitutes a distinct species, *C. matudae* H. Kenn. & Ganders, described herein, that is distinguished by the absence of reduced, basal inflorescences and by the acumen that is always sharply pointed (acute) at the very tip, whereas the acumen is elongated and its very tip blunt to rounded in most, if not all, of the upper bracts in *C. atropurpurea* (compare Fig. 1F and 1E). Another character distinguishing *C. matudae* from *C. atropurpurea* is that the cross veins between the lateral veins of the leaves are farther apart (15 to 20 per 5 mm vs. 23 to 30 per 5 mm in *C. atropurpurea*), when measured in the middle part of each half of the leaf.

In his treatment of the Marantaceae of Chiapas, Matuda (1950: 333) described the new species *Calathea ovandensis*. After examining the type, *Matuda 1568* (holotype, MEXU; isotypes, F, MICH not seen), it was clear that Matuda had typified *C. ovandensis* on a collection of *C. coccinea*. The additional material he cites, *Matuda 5993* (F, LL, MEXU), is also *C. coccinea*. Thus, *C. ovandensis* can be considered as synonymous with *C. coccinea*. However, in reading the description for *C. ovandensis*, it is clear that Matuda also included material of a second taxon (*C. matudae*, described herein). The drawing (Matuda, 1950: 332) is clearly not *C. coccinea*, but another, presumably Chiapan taxon, as are the measurements given for the inflorescence. It is understandable that when comparing material with this published illustration, botanists would adopt the name as being the best fit to a described species of the region. The compact inflorescence with relatively wide, closely overlapping bracts, as illustrated, could hardly be mistaken for that of *C. coccinea*. However, the description of bract length, bract width, and flower color clearly fit *C. coccinea*. Matuda (1950: 335) noted that Standley and Steyermark said that at flowering, *C. coccinea* "no se han desarrollado las hojas aún...," but in his species "...están extendidas las hojas perfectamente...." Although variable, the presence of leaves accompanying the inflorescence is very common in the case of *C. matudae*, but is also seen in Chiapan specimens of *C. coccinea* (*Breedlove 25483*, DS, MEXU, MO; *Utley & Utley 6810*, MO). The distribution and characteristics of the proposed new species *C. matudae* strongly suggest that it is, in fact, this second element included in Matuda's description of *C. ovandensis*. Matuda himself annotated a specimen of it, *Miranda 5397* (MEXU), as *C. ovandensis*.

KEY TO THE SPECIES OF *CALATHEA* SECT. *BREVISCAPUS* IN MEXICO

1a. Corolla red, bracts red (or occasionally green or yellow in *C. misantlensis*).
  2a. Inflorescence subcylindric, 1.3 2.3 cm wide, 2.2 5(–5.7)× longer than wide, borne on leafless shoots ..... *C. coccinea*
  2b. Inflorescence ovoid to broadly ovoid, 2.5 6.5 cm wide, < 2× longer than wide, borne on leafy shoots ..... *C. misantlensis*
1b. Corolla yellow, cream-white, or purple, bracts green or green tinged with purple.
  3a. Bracts glabrous, apex obtuse to rounded in upper bracts; bract apex and margin erect, not recurved; Oaxaca and Veracruz ..... *C. sousandradeana*
  3b. Bracts tomentose, apex acuminate in upper bracts, apex or apex and margin usually recurved; Sinaloa south to Guerrero or Chiapas.
    4a. Acumen of upper bracts elongated, blunted or rounded at very tip; reduced basal inflorescences usually present; 23 to 30 cross veins per 5 mm between the lateral veins in the middle of each half of the leaves; Sinaloa south to Guerrero ..... *C. atropurpurea*
    4b. Acumen of upper bracts not elongated, sharply pointed, acute at very tip; reduced basal inflorescences absent; 15 to 20 cross veins per 5 mm between the lateral veins in the middle of each half of the leaves; Chiapas .... *C. matudae*

1. Calathea matudae H. Kenn. & Ganders, sp. nov. TYPE: Mexico. Chiapas: Mpio. Ocozocoautla de Espinosa, 18 km from Ocozocoautla on rd. to Malpaso, ca. 3200 ft., 1 Aug. 1972, *H. Kennedy & D. E. Breedlove 1414* (holotype, MEXU;

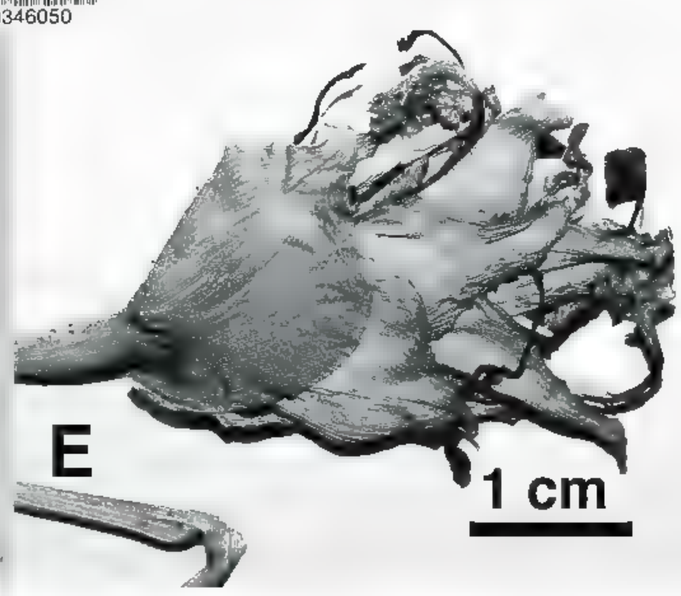


PLANTS OF MEXICO
VERACRUZ

Calathea cyclophora Baker

Region of San Andrés Tixtla wooded stream bed east of S.A.T., August 7, 1953. To ca. 1 m. tall; flowers pale yellow.

Robert L. Dressler and Quentin Jones, No 13



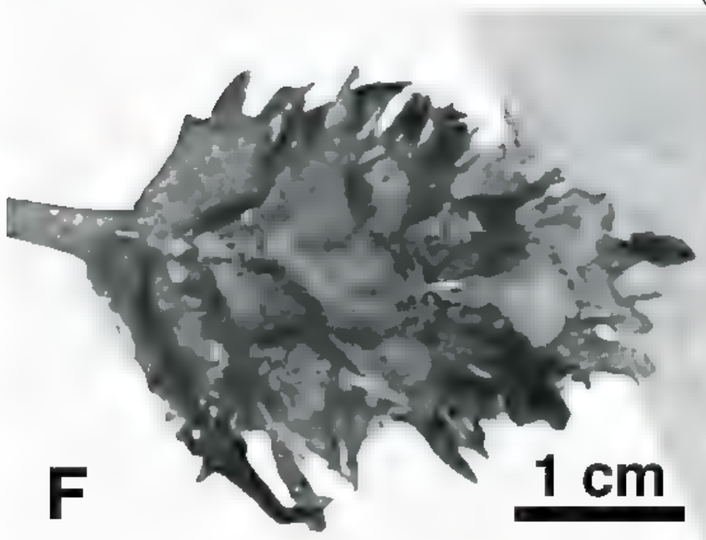


Figure 1. Comparison of inflorescences in *Calathea*. A, B. *C. sousandradeana* H. Kenn. & Ganders. —A. Isotype. —B. Inflorescence with untripped flowers. —C. *C. ovandensis* Matuda. Inflorescence of holotype. D, E. *C. atropurpurea* Matuda. —D. Reduced basal inflorescences. —E. Inflorescence of isotype. —F. *C. matudae* H. Kenn. & Ganders. Inflorescence. Photo in A provided by U.S. National Herbarium, Smithsonian Institution (*Dressler & Jones 13*, US); photo in B by Carol Horvitz (*Horvitz & Cedillo T. 211*, F); photo in C photographed at MEXU (*Matuda 1568*, MEXU); photo in D from scan provided by Kenneth Cameron, Director, University of Wisconsin Herbarium (*Cevallos, Santana & Benz 131*, WIS); photo in E photographed at MEXU (*Matuda et al. 31456*, MEXU 8661); photo in F photographed at TEFH (*Nelson & Martínez 1729*, TEFH).

Figure 2. *Calathea matudae* H. Kenn. & Ganders. —A. Habit. —B. Roots, with tuberlike swellings. —C. Inflorescence. —D. Flower untripped, face view. —E. Flower tripped, side view and capsule with persistent calyx. Photos A, C, and D of the type, *Kennedy & Breedlove 1414* (MEXU, MO, UCR); photos B and E, *Kennedy & House 6200* (DAV, EAP, UCR). Photos by the author.

isotypes, BM, BRIT, CAS, DAV, EAP, GB, MICH, MO, TEFH, TEX, UBC, UCR). Figure 2.

Haec species a *Calathea atropurpurea* Matuda foliorum venis tessellatis remotioribus (15 ad 20 per 5 mm inter venas laterales), inflorescentiis basalibus reductis absentibus atque bracteis in sicco semper brunneis superioribus acumine breviore ad apicem acuto distinguitur.

Deciduous herb, 35–95(–115) cm high, leafy shoots bearing 1 to 4 basal leaves and occasionally 1 cauline leaf; roots bearing subterminal, ellipsoid, starchy, tuberlike swellings; cataphylls herbaceous, narrowly ovate, obtuse, shortly apiculate, green or green tinged with purple, appressed tomentose; innermost cataphyll 8–30 cm; stem tomentose just below node, subglabrous to glabrous basally, green or green tinged with purple, elongated internode above basal leaves, 4–27 cm. Leaves herbaceous, pleated, elliptic, 16–50.5 × 9.8–25 cm, apex obtuse to rounded with acumen, base unequal, broader side

nearly rounded, narrower side broadly acute, ratio of blade widths from midrib at 3 cm above (distal to) junction with pulvinus 1:1.8–4.1; leaf blade grass-green and glittering adaxially, scattered pilose, midrib olive-green, minutely tomentose; leaf surface pale gray-green abaxially, occasionally tinged with pale purple, minutely velvety tomentose, readily felt, midrib light olive-green occasionally tinged with purple, densely appressed tomentose; pulvinus olive-green, greenish brown, or caramel-colored, tomentose throughout, (1.1–)2.3–5.6 cm; petiole dark green, often tinged with purple toward base, appressed tomentose, 0–12(–29) cm; leaf sheath not auriculate, green, darker green or tinged purple basally, appressed tomentose, more densely so along margin and apically, 16.5–35(–61) cm. Inflorescence borne on a separate, nonleafy shoot from the rhizome or terminal on leafy shoot; additional inflorescences sometimes borne in axils of the basal leaves; inflorescences 1 per separate leafless shoot, 1 or 2(to 3) on leafy shoots, ovoid to ellipsoid or subcylindrical, (2.5–)4–5.5(–6.5) × (1.7–)2.3–3(–4.2) cm; peduncle green or green tinged with purple, appressed tomentose near junction with inflorescence, sparsely pilose to subglabrous basally, 24–65 cm; bracts (6 to)10 to 32, spirally arranged, imbricate, outer surface green, minutely appressed tomentose, inner surface green, apical recurved margin minutely tomentose, basal portion glabrous, the outermost 0.3–0.4 mm of margin hyaline; broadly transverse ovate in lowermost 3 or 4 bracts, basalmost bract may be retuse with central acumen, ovate to ovate-elliptic in subsequent ones, longer than wide, rounded to obtuse with an abrupt elongated acumen in lower bracts to acuminate in upper ones, outer margin and apex recurved or occasionally just the margins recurved, 1.1–2.8 × 1.2–2.4 cm; each bract subtending 2 to 6 flower pairs; bicarinate prophyll membranous, elliptic, apex rounded, translucent faint yellowish, glabrous, 1.1–1.4 × 0.7–1.1 cm, 0.6–0.9 cm wide from carina to carina; secondary bract membranous, elliptic, apex rounded, translucent pale yellow, glabrous, (0.5–)0.7–0.9 cm; bracteoles 1 per flower pair, medial, indurate, claviculate, linear, light tannish yellow, 1.15–1.6 cm. Sepals membranous, obovate, acute to 90°, cream to white, glabrous, 10.5–13 mm; corolla tube pale yellow to cream-colored, glabrous, 13–16 mm; corolla lobes subequal, elliptic, apex obtuse, yellow, glabrous, ca. 12–13 mm (flower purple and white, fide *Breedlove 38059*, *Croat 40643*); outer staminode elliptic, clawed at base, yellow, lighter toward base, with or without purple streaks, ca. 10–11 × 6–6.5 mm; callous staminode petaloid apically, spatulate, apex bilobed, yellow or tinged purple apically, paler basally, ca. 12 mm; cucullate staminode yellow or cream, apex likewise or tinged purple, 5–6 mm; stamen with lateral petaloid appendage, cream-white; anther cream; ovary cream to white, glabrous, 1.5–2 × 1–1.5 mm; style and stigma cream-colored. Capsule fleshy, obpyramidal with raised outer rim, cream to white, glabrous, 8–9 × 8–9 mm, crowned by a persistent calyx; seeds usually 3 per capsule, trigonous, outer surface rugose, gray, ca. 4 × 4 × 3 mm, bearing a white aril.

Distribution and phenology. *Calathea matudae* occurs from Chiapas, Mexico, southeast to Olancho Department, Honduras, at mid to higher elevations from 650 to 1600 m. According to specimen data, it was found in a fairly broad range of habitats from transitional tropical dry and deciduous forests to subtropical wet and montane rainforests. It was often noted in association with *Liquidambar* L. or *Pinus* L.–*Liquidambar* overstories.

As would be expected with a deciduous plant, growth and flowering occur in the rainy season, from May to September, but as early as March in Honduras and as late as October in Chiapas. In flowering individuals, the inflorescence is frequently on the first shoot produced, which is usually a leafless shoot bearing only cataphylls basally. Subsequently, leafy shoots are usually produced in the axils of the cataphylls or as separate shoots from the rhizome. These leafy shoots often bear inflorescences. Occasionally, the leafy shoots may be the first to emerge and flower.

IUCN Red List category. Conservation for *Calathea matudae* must be considered as Least Concern (LC) according to IUCN Red List criteria (IUCN, 2001), because it is known from many localities from Chiapas, Mexico, through Guatemala to Olancho Department, Honduras, at elevations from 650 to 1600 m.

Etymology. This species is named in honor of Eizi Matuda (1894–1978) for his many contributions to Mexican botany, especially for the Marantaceae of Chiapas.

Common names. The new species has been identified as "platanillo" and "chufle" (*MacVean s.n.*, UVAL 74108) in Guatemala, and as "macuz" (*Nelson & Martínez 1729*) and "lirio de montaña" (*Molina R. 2955*) in Honduras.

Discussion. *Calathea matudae* is distinguished by the deciduous habit; the leaf blade that is pilose adaxially and velvety tomentose abaxially; the absence of reduced basal inflorescences; the spirally arranged, tomentose green bracts with recurved margins and with the acumen acute at the tip; the claviculate bracteoles; and the yellow to cream or

purple mottled corolla and staminodes. *Calathea atropurpurea* often retains a greenish color to the bracts, especially the acumen, when dried, whereas in *C. matudae* (and the second new species herein) the bracts dry brown. As in *C. atropurpurea*, to which *C. matudae* is closely related, there is variation in flower color from yellow to white or purple. In the type population, the corollas were yellow and the staminodes pale yellow streaked or tinged with purple. Flowers of other Chiapan specimens are described as white and purple, yellow and purple, or pale yellow lined with lavender. In the majority of Honduran specimens, flowers are noted as being cream or yellow, the corolla yellow, and the staminodes light yellow. However, two Molina collections from Francisco Morazán Department (*Molina R. 2855, 2955* [EAP]) are described as having "flores azules" and "flores morado pallido."

Paratypes. GUATEMALA. **Suchitepéquez:** Agropecuaria la Corona, Chicacao, 14°34′37″N, 91°16′45″W, 30 Mar. 2003, *A. L. MacVean s.n.* (UVAL 74108). HONDURAS. **Comayagua:** ca. 14 km E of Lago Yojoa, just outside San José de Los Planes, along Quebrada Agua Helada, 14°47′N, 87°51′W, Mar. 1993, *R. Evans 1334* (EAP, MO); region of Buenas Aires, 14°51′01″N, 88°01′30″W, 20 Aug. 2006, *H. Kennedy & P. House 6200* (DAV, EAP, UCR); Desvio El Coco, ca. 3 km from jct. along rd. to Buenas Aires, 14°52′35″N, 88°01′28″W, 20 Aug. 2006, *H. Kennedy & P. House 6212* (EAP, UCR); 1.5 km S of Las Lajas, Montaenualas Quad 444,450 E, 1639,900 N, 14°49′37″N, 87°30′48″W, 23 June 1981, *R. A. Meigs & D. Lentz 1491* (TEFH, UNA); Quebrada de Barranoc de Trincheras, 13 May 1956, *A. Molina R. 6971* (EAP); Montaña La Choca, Cordillera Comayagua, cerca de Coyocutena, 22 May 1956, *A. Molina R. 7107* (EAP, F); Montaña La Choca en Cordillera Comayagua, cerca de Coyocutena, 14 Apr. 1957, *A. Molina R. & A. R. Molina 8121* (EAP, F, NY, US); 1 km al S de La Misión, sobre rocas del barranco, 20 July 1962, *A. Molina R. 10937* (EAP, F, NY); Villa de Taulabé, Quebrada La Caliche, 12 13 June 1976, *C. Nelson et al. 3518* (EAP, TEFH); Villa de Taulabé, Quebrada La Caliche, 14°41′21″N, 87°57′39″W, 21 Apr. 1978, *L. Tróchez 26* (MO). **Francisco Morazán:** Montaña Zamquín, 14 May 1950, *A. Molina R. 2855* (EAP); Montaña Zamquín, Quebrada de La Páz, 23 May 1950, *A. Molina R. 2955* (EAP, F, GH, US). **Olancho:** Mpio. La Unión, ca. 10 mi. E of La Unión along rd. to Olanchito, ca. 15°03′N, 86°35′W, 1 July 1994, *G. Davidse 35453* (EAP, MO, TEFH); Montaña Peña Blanca, ca. de Quebrada Catacamas, 27 Apr. 1957, *A. Molina R. 8380* (EAP, F, WIS); Montaña Cara Sucia, 10 km O de Campamento, 20 Sep. 1986, *C. Nelson 9876* (TEFH); 8.5 km NE de Catacamas, márgines del Río Talgua (Cuevas del Talgua), 10 May 1987, *A. Ortega U. 320* (MO, TEFH); Orillas del Río Real, a 8 km E of Catacamas, 20 May 1988, *M. L. Palacios 225* (TEFH); trail betw. Catacamas & La Presa, N of Catacamas, 14°50′N, 85°53′W, 20 25 Mar. 1949, *P. C. Standley 18699* (EAP, F); Represa Santa María del Real, 15 km al NO de Catamacas, 30 Apr. 1988, *L. Velásquez 182* (TEFH). **Santa Bárbara:** Punta Gorda, Lago Yojoa, 14°53′N, 88°00′W, *R. Evans 1791* (EAP, HEH, MO, TEFH); Montaña Las Ventanas, Lago de Yojoa, 18 Aug. 1988, *R. Zúniga 713* (TEFH). **Yoro:** Yoro near Pte. Grande on tributary of Río Agua (Río Pte. Grande), 22 May 1987, *S. Blackmore & M. Chorley 4065* (BM, MO); Camino de la ciudad de Yoro, a la montaña Buenos Aires, 28 Mar. 4 Apr. 1974, *C. Nelson & J. Martínez 1729* (EAP, TEFH). MEXICO. **Chiapas:** Mpio. Ocozocoautla de Espinosa, 18–20 km N of Ocozocoautla on rd. to Mal Paso, 18 Aug. 1972, *D. E. Breedlove 27131* (DS, LL, MO); Mpio. Ocozocoautla de Espinosa, 32 km N of Ocozocoautla on rd. to Mal Paso, 6 Oct. 1974, *D. E. Breedlove 38159* (DS); Mpio. Ocozocoautla de Espinosa, 22 km N of Ocozocoautla, 9 Oct. 1980, *D. E. Breedlove & J. Strother 45997* (CAS); Mpio. Ocozocoautla de Espinosa, 20 mi. N of Ocozocoautla along gravel rd. to Apitpac near Km 31 marker, 9 July 1977, *T. B. Croat 40643* (MO); Mpio. Ocozocoautla de Espinosa, Km 18 on rd. to Malpaso from Ocozocoautla, 16 Aug. 1972, *H. Kennedy, G. L. Webster & S. Lynch 1489* (MEXU); Mpio. Cintalapa, NE of Cintalapa, 3 km E of Francisco Madero, at ridge crest, 18 Aug. 1972, *D. E. Breedlove 38059* (DS, MO); Mpio. San Fernando, at rd. tunnel from Tuxtla Gutierrez to Chicoasen Dam, 9 Sep. 1976, *D. E. Breedlove 40003* (DS); Mpio. San Fernando, 20 km NW of San Fernando beyond Colonia Cuahtemoc, 18 May 1988, *D. E. Breedlove & M. Bourell 68272* (CAS); Mpio. Berriozábal, La Vistas al N Berriozábal, 17 July 1959, *D. Miranda 5397* (MEXU).

2. Calathea sousandradeana H. Kenn. & Ganders, sp. nov. TYPE: Mexico. Veracruz: Mpio. San Andrés Tuxtla, region of San Andrés Tuxtla, E of San Andrés Tuxtla, wooded stream bed, 7 Aug. 1953, *R. L. Dressler & Q. Jones 13* (holotype, MEXU; isotypes, GH, MICH, NY, UC, US). Figure 1.

Haec species a *Calathea atropurpurea* Matuda et *C. matudae* H. Kenn. & Ganders bracteis minoribus glabris apice margineque erectis superioribus apice obtusis rotundatisve distinguitur.

Deciduous rhizomatous herb, 36–86 cm high, bearing 1 to 3(to 6) basal leaves and 0 or 1 cauline leaf, borne above a 5.5–33 cm stem internode; stem green, sparsely pilose, hairs to 0.5 mm; roots bearing subterminal, ellipsoid, starchy, tuberlike swellings; cataphylls herbaceous, narrowly ovate, apiculate, appressed tomentose, hairs sparse at very base; innermost cataphyll (8.5–)11–24.5 cm; leaf blades herbaceous, slightly pleated, ovate, occasionally elliptic, (15.2–)20–39 × (8.5–)10–19 cm, apex obtuse with acumen to abruptly acuminate, base obtuse to rounded, abruptly attenuate, somewhat unequal; leaf blade glittering deep green adaxially, scattered pilose, hairs borne on raised cushion of cells, hairs 0.25–0.3 mm, midrib light green, appressed tomentose medially; leaf surface light gray-green abaxially, densely velutinous, hairs 0.1–0.2 mm, midrib appressed tomentose; pulvinus 1.4–3.1(–3.8) cm, olive-green, minutely tomentose throughout but occasionally tomentose adaxially, glabrous to subglabrous abaxially, hairs 0.2–0.5 mm, longest adaxially; petiole

green, moderately to densely tomentose, (0–)1.2–28.5 cm; leaf sheath not auriculate, 11–37.5 cm, green, appressed tomentose, hairs readily felt, denser apically, sparse toward base. Inflorescence 1 per shoot, terminal on the leafy shoot or borne on a separate leafless shoot, often appearing before the leafy shoot develops, ovoid to ellipsoid, 2.6–4.5(–5) × (1.2–)1.8–2.2(–2.5) cm; peduncle green, 28–41.5 cm, apicalmost 1–2 cm just below inflorescence glabrous, then pilose to base; bracts 11 to 19, spirally arranged, imbricate, herbaceous, broadly transverse ovate in lower ones, ovate in uppermost bracts, apex of lowermost bract obtuse with acumen to acuminate, apex obtuse to rounded in upper ones, outer margin and apex straight, not recurved, 1–1.7(–2) × 0.95–1.6 cm; each bract subtending up to 6 or more flower pairs; outer surface of bracts green, glabrous; inner surface green, glabrous; bicarinate prophyll membranous, broadly ovate to subelliptic in upper bracts, apex broadly obtuse, occasionally retuse, wings extending above center back, translucent faint greenish white, glabrous, 0.9–1.2 × 0.6–1.1 cm, 0.4–0.7 cm wide from carina to carina; secondary bract membranous, elliptic, apex shallowly emarginate, translucent faint greenish white, glabrous, 0.9–1.1 × 0.5–0.7 cm; bracteoles 1 per flower pair, medial, claviculate, apical portion triangular in cross section, straw-colored, 0.95–1.35 cm. Sepals herbaceous, narrowly elliptic, obtuse, pale cream-colored, glabrous, 9.5–11 × 2–3 mm; corolla tube cream to light yellow, glabrous, 12–15 mm; corolla lobes subequal, elliptic, obtuse, yellow, glabrous, 8–10 × 3.5–4 mm; staminodes yellow; outer staminode elliptic, emarginate, 7–9 × ca. 6 mm; callous staminode petaloid apically, spatulate, apex bilobed, 8–10 × ca. 6 mm; cucullate staminode 5–6 mm; filament pale yellow, anther yellow, ca. 2 mm; ovary smooth, cream-white, glabrous, 1.5–2 × 1–1.5 mm; style and stigma yellow, back of style turning brownish after being tripped by pollinator. Capsule smooth, obpyramidal with raised rim, glabrous; crowned by a persistent calyx; seeds usually 3 per capsule, trigonous, outer surface rugose, ca. 5 × 4.5 × 4 mm, bearing a white aril to 4 mm high.

Distribution, phenology, and natural history. *Calathea sousandradeana* is endemic to Oaxaca and Veracruz, Mexico, at low elevations from 10 to 400 m. The most common habitats noted are tropical rainforest, tall evergreen forest, and medium semievergreen forest, mostly secondary or disturbed areas, primarily on limestone soils (suelo kárstico). In some sites, the new species is associated with *Brosimum* Sw., *Cedrela* P. Browne, *Ficus* L., or *Bursera* Jacq. ex L. Flowering is in the rainy season, from June through October. Fruiting is concomitant with flowering throughout most of the rainy season. Capsules expand to full size in ca. 14 days after pollination (Schemske & Horvitz, 1989: 462) and dehisce after ca. 32 days (Schemske & Horvitz, 1988). Horvitz and Schemske (2002: 281) note that "new seeds are dormant until at least the subsequent rainy season."

Calathea sousandradeana is certainly the most comprehensively studied species of *Calathea*, as evidenced by the many papers cited in Horvitz and Schemske (2002), where it was called *C. ovandensis* Matuda. This species is bee pollinated, mainly by euglossine bees, but also by species of *Rhathymus* Lepeletier & Serville (Schemske & Horvitz, 1988. The claviculate bracteoles function as extrafloral nectaries and are visited by ants. The significance of these ant-plant interactions was documented by Horvitz and Schemske (1984, 1988). Immatures of the butterfly *Eurybia elvina* Stichel feed on buds and flowers (Horvitz et al., 1987). The seeds are ant dispersed, with the ants collecting them for the "lipid-rich aril that is used as food" (Horvitz & Schemske, 1986: 319).

IUCN Red List category. Conservation for *Calathea sousandradeana* must be considered as Least Concern (LC) according to IUCN Red List criteria (IUCN, 2001), because it is known from many localities in Oaxaca and Veracruz, Mexico, at elevations from 10 to 400 m.

Etymology. This species is named in honor of Mario Sousa S., former director of Universidad Nacional Autónoma de México herbarium (MEXU), and his wife Gloria Andrade M. for their unstinting help to innumerable visiting botanists and specifically in gratitude for their aid to my Marantaceae studies, both recently and as a graduate student.

Discussion. This species often produces an inflorescence on a leafless shoot, which may appear before a separate leafy shoot develops. This initially leafless shoot, terminating in an inflorescence, may subsequently produce leafy shoots in the axils of the cataphylls, which in turn may bear inflorescences. These inflorescences are normal and on leafy shoots, unlike the reduced basal inflorescences produced by *Calathea atropurpurea*.

Like *Calathea atropurpurea* and *C. matudae*, *C. sousandradeana* is also deciduous, with leaves pilose adaxially, green spirally arranged bracts, claviculate bracteoles, and yellow flowers. This new species differs from both *C. atropurpurea* and *C. matudae* in the generally smaller inflorescences, glabrous bracts with erect, nonrecurved margins, and the obtuse to rounded apex of the upper bracts. The flower color

does not appear to be as variable as in *C. matudae*, with no mention of purple. Flower color for *C. sousandradeana* was given as yellow in all but one of the paratype collections (*C. Martínez R. 1073*, TEX), where it was noted as "blanca." This new species differs from *C. atropurpurea* in lacking reduced basal inflorescences. It is of geographical interest because it occupies the lowland areas in between the distributional ranges of *C. atropurpurea* and *C. matudae*.

Paratypes. MEXICO. **Oaxaca:** Distr. Tuxtepec, Mpio. Soyaltepec, Presa Temascal, al NO sobre la cortina de la presa, 8 Sep. 1985, *L. Cortes A. & R. Torres C. 5* (CAS, MO); lado N de la cortina de Presa Temascal, 12 June 1987, *L. Cortes A. et al. 902* (F, MO); Orilla E de la Presa de Temazcal, 100 m al N de la cortina, 23 Dec. 1986, *A. Garcia M. et al. 2716* (RSA); Cerros Kársticos frente a las bombas de auxiliación de la Presa Miguel Alemán, Temascal, 22 Sep. 1984, *R. Torres C. & E. Cabrera 6127* (MO); Mpio. Acatlán, Cerro del Tigre, 3 km al Ede Acatlán via Tierra Blanca Acatlán, 25 Aug. 1986, *L. Cortes A. & R. Torres C. 474* (F); Distr. Tuxtepec, Tuxtepec to Oaxaca, 5 km S of Tuxtepec, 26 Sep. 1986, *B. Hammel & M. Merello 15460* (MO); Distr. Juchitán, Mpio. Matías Romero, Los Angeles 20 km al NO del entronque con la carr. Matías Romero Acayucan, la entrada se encuentra adelante de Martía Dehesa, 23 Oct. 1987, *C. Martínez R. 1073* (TEX); Mogoñe (on Ferro Caril N.T.), 9 June 1910, *C. R. Orcutt 5225* (DS, MO); Cerro de Sebastopol, near Fabrica Papel, ca. 8.5 mi. by rd. SW from Tuxtepec, ca. 18°05′N, 96°08′W, 21 June 1969, *G. L. Webster & G. Breckon 15404* (DAV). **Veracruz:** Mpio. San Andrés Tuxtla, about 5 km al NE de San Andrés Tuxtla, Laguna Encantada, 28 June 1972, *J. H. Beaman 6299* (TEX, UCR, XAL); Catemaco, 1953, *H. Bravo 31* (MEXU); Laguna Escondida, 23 Nov. 1969, *G. M. Calderon 2107* (GH); 8 km al N de San Andrés Tuxtla, Laguna Encantada, 18°31′N, 95°09′W, 23 Sep. 1974, *J. I. Calzada 1512* (MO, NY); 8 km al N de San Andrés Tuxtla, Laguna Encantada, 18°28′N, 95°10′W, 4 Sep. 1981, *J. I. Calzada 8098* (MEXU, XAL); 1 km al N de San Andrés Tuxtla, Laguna Encantada, 9 Aug. 1983, *R. Cedillo T. 2430* (MEXU, MO, TEX); 3 km NE of San Andrés Tuxtla, on rim & steep slopes around a lake-filled volcanic crater, 18°27′30″N, 95°11′15″W, 2 July 1982, *M. Nee et al. 24757* (BRIT, MO, NY, XAL); Mpio. Hueyapan de Ocampo, Los Mangos, ca. 22°13′N, 97°49′W, 12 Sep. 1972, *R. Cedillo T. & J. I. Caldada 28* (MEXU, UCR); Los Chorros, cerca del camino San Andrés Tuxtla y Cerro Amarillo, 8 Sep. 1977, *C. Horvitz & R. Cedillo T. 211* (F, NY). **State Unknown:** Novae Hispaniae, 1787-1795-1804, *Sessé et al. 87* (F 846441, as "*Amomum*").

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Calathea leonoriae (Marantaceae), una Nueva Especie de Veracruz, México

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Resumen. Se describe e ilustra una nueva especie de Veracruz, México, *Calathea leonoriae* Lascur., H. Oliva & Avendaño (Marantaceae). Esta nueva especie es morfológicamente cercana a *C. ovandensis* Matuda, sólo conocida de México, pero difiere tanto en el tamaño de la planta y el hábito de crecimiento, como en el tamaño y forma en que emerge la inflorescencia.

Abstract. *Calathea leonoriae* Lascur., H. Oliva & Avendaño (Marantaceae) is described and illustrated as a new species from Veracruz, Mexico. It is morphologically close to *C. ovandensis* Matuda, which is only known from Mexico, differing only in plant size and growth habit, as well as in the size and the way in which the inflorescence emerges.

Key words: *Calathea*, IUCN Red List, Marantaceae, Mexico, Río Atoyac, Veracruz.

Con base en estudios realizados de la familia Marantaceae de Veracruz (Lascurain, 1995, 1996), nuevas observaciones de campo, revisión de material de herbario e incremento en el número de especies del género *Calathea* G. Mey. en la colección viva del Jardín Botánico Francisco Javier Clavijero, del Instituto de Ecología, A.C. en Xalapa, Veracruz, fue posible concluir que la población de *Calathea* del Río Atoyac, es distinta al resto de las especies.

Calathea leonoriae Lascur., H. Oliva & Avendaño, sp. nov. TIPO: México. Veracruz: Mpio. Amatlán de los Reyes, La Maquinaria, nacimiento del Río Atoyac, 12 km al E de Córdoba, 560 m, 18°55′34″N, 96°51′79″W, 28 jul. 2008, *H. Oliva, H. Flores y A. Martínez 3080* (holotipo, XAL; isotipos, CORU, MEXU, MO). Figura 1.

Haec species *Calatheae ovandensi* Matuda similis, sed ab ea petiolo plerumque breviore, pedunculo breviore foliato e vagina foliari superiore emergente, inflorescentia longiore, bracteis pluribus, floribus flavis atque tubo corollino breviore distinguitur.

Plantas de 55–83 cm de altura; tallo grueso, pubescente, de color verde oscuro. Hojas ligeramente corrugadas, las caulinares 2(3), las basales 1 o 2; lámina ovada, 29–37 × 14–17 cm, haz de color verde oscuro con abundantes pelos diminutos, envés de color verde claro ligeramente piloso, el ápice apiculado a agudo, la base obtusa a redondeada; pecíolo 9.5–16 cm, pubescente; pulvínulo pubescente, 4–6 cm, elíptico en corte transversal; catafilos pubescentes de 4–16 × 1–1.5 cm; vaina no auriculada que abraza parcialmente el pedúnculo de la inflorescencia. Inflorescencia axilar 6–11 cm, una por vástago, capitada o estrobiliforme, pedúnculo 17–25 cm; brácteas hasta 22, ovadas a ampliamente ovadas, suaves, de color verde en fresco, fibrosas cuando secas, con 2 pares de flores imbricadas, las basales ca. 15 × 20 mm, ápice apiculado, las superiores de 18–20 × 6–8 mm, ápice agudo, ambos tipos con el haz casi glabro en la parte media y con pelos esparcidos en los márgenes, envés glabro; profila bicarinada, ca. 15 × 3.2 mm, membranosa, translúcida; interfila ca. 1.5 cm, membranosa translúcida; bracteolas membranosas, aciculares, 11–12 mm de largo. Flores amarillas; sépalos oblanceolados,

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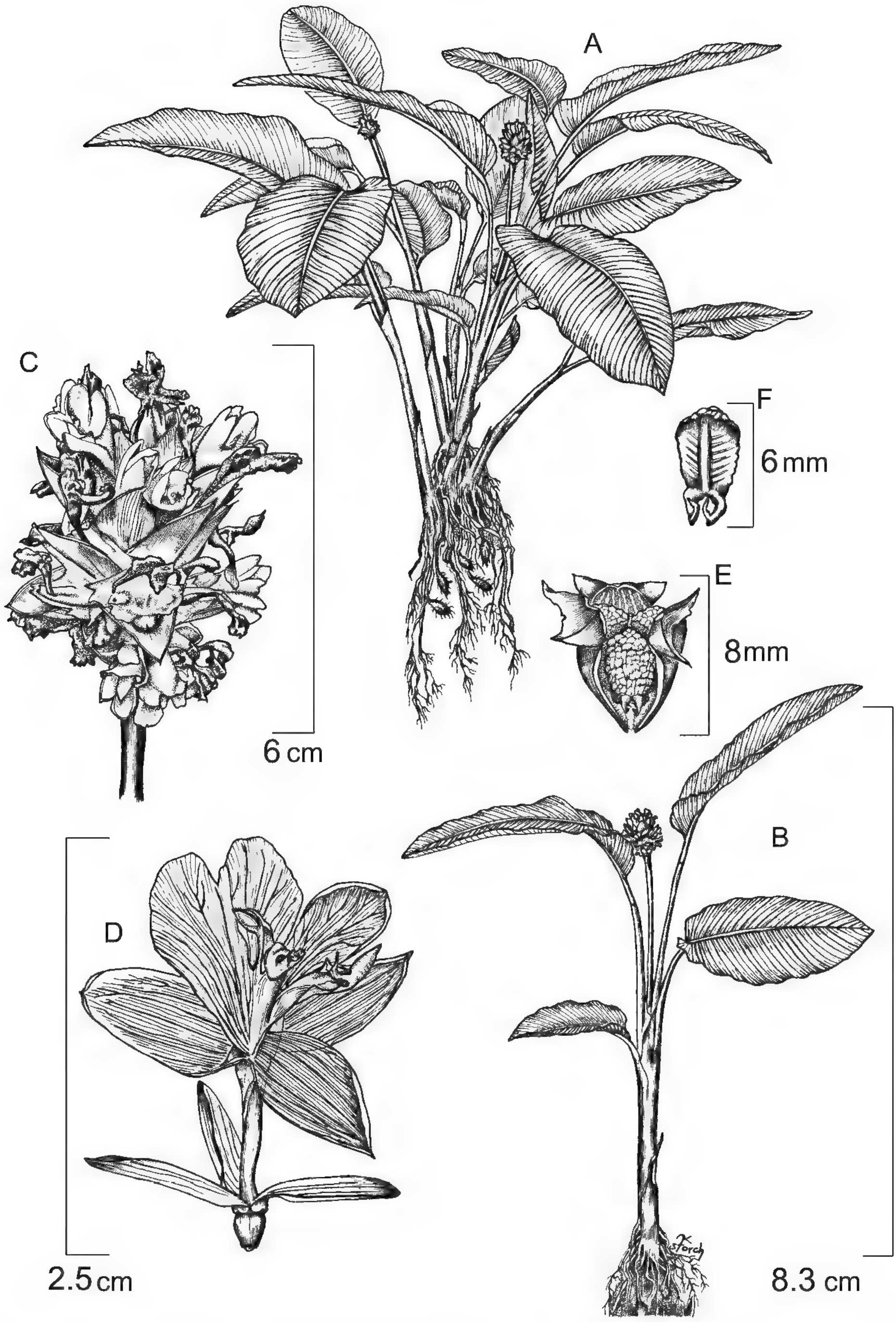

Figura 1. *Calathea leonoriae* Lascur., H. Oliva & Avendaño. —A. Hábito. —B. Planta fértil. —C. Inflorescencia. —D. Flor. —E. Cápsula con semilla. —F. Semilla. Dibujo del paratipo *Lascurain 350* (XAL). A de la misma escala que B.

ca. 10 × 5 mm, membranáceos, dilacerados, ápice obtuso; tubo de la corola ca. 14 mm, glabro; estaminodio externo ca. 10 × 6 mm, espatulado, bilobado; estaminodio calloso, ca. 14 × 9 mm y en la parte superior media un callo de 5 mm; estaminodio cuculado, ca. 8.7 mm; estambre ca. 12 mm, con margen petaloide de un sólo lado; ovario glabro, ca. 3.2 mm. Fruto una cápsula obovoide, 8 mm; semilla

Tabla 1. Comparación entre *Calathea leonoriae* y *C. ovandensis*.

Características	*C. leonoriae*	*C. ovandensis*
Altura de la planta (cm)	55–83	50–65
Largo/ancho de la hoja (cm)	29–37 × 14–17	25–35 (largo)
Longitud del pecíolo (cm)	9.5–16	15–45
Longitud inflorescencia (cm)	6–11	2.5–4
Longitud del pedúnculo de la inflorescencia (cm)	17–25	30–90
Brácteas largo/ancho (mm)		
Basales	ca. 15 × 20	ca. 15 × 7
Superiores	18–20 × 6–8	
Número de brácteas	hasta 22	8 a 10
Color de las flores	amarillas	rojas
Tubo de la corola (mm)	ca. 14	ca. 20

blanquecina, ca. 6 mm de largo, rugosa, el arilo conspicuo.

Distribución, hábitat y categoría de la Lista Roja de UICN. Hasta la fecha *Calathea leonoriae* sólo se conoce del municipio de Amatlán de los Reyes en las riveras del Río Atoyac, es abundante en esta región del estado de Veracruz y no se ha localizado en otras partes del país. Estas áreas actualmente están siendo modificadas debido al cambio en el uso del suelo y aunado a su distribución restringida podría ser considerada una especie Vulnerable (VU) según los criterios de la Unión Internacional para la Conservación de la Naturaleza (IUCN, 2001).

Calathea leonoriae forma parte del estrato herbáceo en las orillas de plantaciones de café ubicadas a lo largo del Río Atoyac. Crece en suelos arcillosos y húmedos, con abundante sombra a una altitud de ca. 560 m. La vegetación original es de selva mediana subperennifolia, constituida entre otras especies por *Cordia alliodora* (Ruiz & Pav.) Oken, *Bursera simaruba* (L.) Sarg., *Quararibea funebris* (La Llave) Vischer, *Bernoullia flammea* Oliv., *Alchornea latifolia* Sw., *Croton draco* Schltdl. & Cham., *Pleurantho-dendron lindenii* (Turcz.) Sleumer, *Licaria capitata* (Schltdl. & Cham.) Kosterm., *Lonchocarpus* Kunth sp., *Robinsonella mirandae* Gómez Pompa, *Ficus* L., *Ruprechtia pallida* Standl., *Annona purpurea* Moc. & Sessé ex Dunal y *Dendropanax arboreus* (L.) Decne. & Planch.

Fenología y usos. *Calathea leonoriae* florece de junio a octubre. Como sucede con otros taxones del género *Calathea* en México (Lascurain, 1995), las hojas de esta especie son utilizadas como envoltura de tamales y se conoce localmente como platanillo.

Etimología. Esta especie está dedicada a Leonor Rangel de Lascurain, madre de la primera autora, quien dedicó más de 50 años de su vida al cultivo de plantas nativas de Veracruz.

Discusión. *Calathea leonoriae* es cercana a *C. ovandensis* Matuda pero se diferencia de ésta porque *C. ovandensis* mide hasta 65 cm de altura, pecíolo de 15–45 cm, pedúnculo de la inflorescencia sin hojas que emerge del rizoma con flores de color rojo y el tubo de la corola de ca. 20 mm de largo (Matuda, 1950). Con frecuencia *C. leonoriae* se determina como *C. ovandensis* en ejemplares de herbario, sin embargo, la nueva especie mide hasta 83 cm de altura, pecíolo 9.5–16 cm, pedúnculo con hojas que salen de una hoja superior, presenta flores amarillas y el tubo de la corola de ca. 14 mm (Tabla 1).

Paratipos. MÉXICO. **Veracruz:** Mpio. Amatlán de los Reyes, La Maquinaria, 10 oct. 1987, *H. Oliva 401* (CORU, XAL); nacimiento del Río Atoyac, a 12 km E de Córdoba, 6 nov. 2005, *M. Lascurain 350* (CORU, XAL).

Agradecimientos. Los autores agradecen los valiosos comentarios de Rodrigo Duno y Francisco Lorea, a Karla Storch por la ilustración, a Antonio Vázquez Blanco por su ayuda en el trabajo de campo y al personal del Jardín Botánico Francisco Javier Clavijero del Instituto de Ecología, A.C., por mantener las plantas vivas para su observación.

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Lascurain, M. 1996. A New Species of *Calathea* (Marantaceae) from Veracruz, Mexico. Novon 6: 385 388.

Matuda, E. 1950. Estudio de las plantas de Chiapas. VIII. Marantáceas de Chiapas. Anales Inst. Biol. Univ. Nac. México 21: 321 343.

Validation of the Name *Asparagus kansuensis* (Asparagaceae)

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ABSTRACT. The species *Asparagus kansuensis* F. T. Wang & T. Tang ex S. C. Chen (Asparagaceae) from China was invalidly published in 1978, because two types were simultaneously indicated. The plant name is validly published here, but otherwise refers to the 1978 diagnosis. Thus, the original ascription to authors is kept.

Key words: Asparagaceae, *Asparagus*, China.

Asparagus kansuensis F. T. Wang & T. Tang ex S. C. Chen is a dioecious species in the family Asparagaceae. The describing author designated a mixed collection of both staminate and pistillate plants from obviously separate gatherings as the type, *K. S. Hao 416* (Chen, 1978). We examined specimens cited by Chen as type and found three sheets at PE, all attributed to the type collection *K. S. Hao 416*. One of these sheets indicated as typus included two gatherings, represented by one staminate plant and one pistillate plant on a single herbarium sheet (Fig. 1). This specimen exactly corresponds to the illustration in Chen (1978). The other sheets collected as *K. S. Hao 416* consist of only pistillate plants. Therefore, the publication of the name *A. kansuensis* was invalid, because at least two gatherings from different plants are represented by *Hao 416* and these separate specimens were simultaneously indicated as type (Chen, 1978). Thus, this species requires validation now, by indicating a single gathering as the holotype, in accordance with Articles 37.1, 37.2, 8.1, and 8.2 of the *International Code of Botanical Nomenclature* (McNeill et al., 2006). The mixed gathering cannot be selected as lectotype, viz. Articles 9.2 and 9.15, or regarded as syntypic (Art. 9.4).

Without consideration of the validity of the name, Chen and Tamanian (2000) accepted *Asparagus kansuensis* for their treatment in volume 24 of the *Flora of China*, not realizing that the type collection was a mixed gathering. The current paper validates this name by reference to the Latin diagnoses in the original publication and by indicating one of the mixed specimens (the staminate element for the dioecious plants) as the holotype. The correct authorship of this name remains F. T. Wang & T. Tang ex S. C. Chen because both the plant name and the validating diagnosis for this species may be ascribed to them, according to Article 46.2 of the *International Code of Botanical Nomenclature* (McNeill et al., 2006).

Asparagus kansuensis F. T. Wang & T. Tang ex S. C. Chen, sp. nov. *Asparagus kansuensis* F. T. Wang & T. Tang ex S. C. Chen, Acta Phytotax. Sin. 16(1): 94, nom. inval. TYPE: China. Gansu: Wenxian, 910 m, 15 June 1930 (♂ fl.), *K. S. Hao 416a* (holotype, PE 00034519).

Discussion. The validating diagnosis appeared in Chen (1978: 94).

Paratypes. CHINA. **Gansu:** Wenxian, 910 m, 15 June 1930 (♀), *K. S. Hao 416b* (PE 00034519), (♀), *K. S. Hao 416c* (PE 00218312), (♀), *K. S. Hao 416d* (PE 00218311); Wenxian, (♀), *Z. Y. Zhang 7085* (PE).

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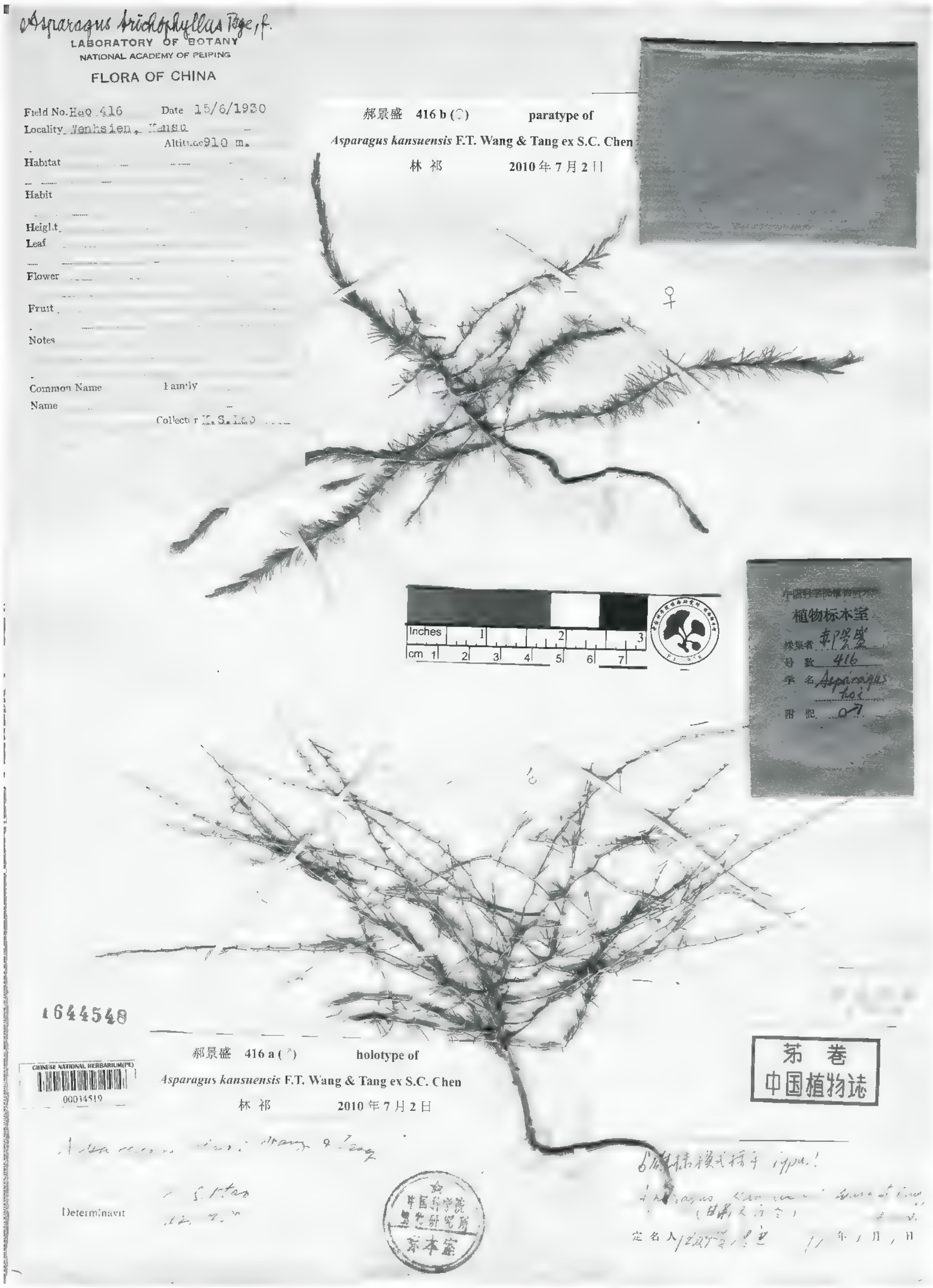

Figure 1. Photograph of the type of *Asparagus kansuensis* F. T. Wang & T. Tang ex S. C. Chen (*K. S. Hao 416a* [♂]). The holotype is represented by the staminate plant at the bottom of the sheet. The pistillate plant above represents *Hao 416b* (♀), here regarded as a paratype.

Validation of Two Names, *Berchemia omeiensis* and *Rhamnus kwangsiensis* (Rhamnaceae)

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ABSTRACT. Two species from China, *Berchemia omeiensis* W. P. Fang ex Y. L. Chen & P. K. Chou and *Rhamnus kwangsiensis* Y. L. Chen & P. K. Chou (Rhamnaceae), were published invalidly in 1979 because in each instance two types were simultaneously indicated. Both plant names are validly published here.

Key words: *Berchemia*, China, Rhamnaceae, *Rhamnus*.

Two species of Rhamnaceae from China, *Berchemia omeiensis* W. P. Fang ex Y. L. Chen & P. K. Chou (Chen & Chou, 1979a) and *Rhamnus kwangsiensis* Y. L. Chen & P. K. Chou (Chen & Chou, 1979b) (Rhamnaceae), were not validly published because in each instance two types were simultaneously indicated. According to Articles 37.1 and 37.2 of the *International Code of Botanical Nomenclature* (McNeill et al., 2006), the two names were invalid. Without commenting on the validity of publication, Chen and Schirarend (2007: 129, 149) later utilized both plant names in volume 12 of the *Flora of China*. The current paper validates the two names by reference to the Latin diagnoses in the original publications (Chen & Chou, 1979a, 1979b) and by indicating for each name one of the two specimens cited by Chen and Chou as the holotype. The correct author attribution for the plant names is Y. L. Chen & P. K. Chou because the name and the validating diagnosis for both species are clearly ascribed to them (cf. Art. 46.2, McNeill et al., 2006).

Berchemia omeiensis W. P. Fang ex Y. L. Chen & P. K. Chou, sp. nov. *Berchemia omeiensis* W. P. Fang ex Y. L. Chen & P. K. Chou, Bull. Bot. Lab. N. E. Forest. Inst., Harbin 5: 16. 1979, nom. inval. TYPE: China. Sichuan: Mt. Emei, 25 May 1957, *G. H. Yang 54723* (holotype, PE 00023541).

Discussion. *G. H. Yang 54723* (PE) is chosen as the holotype because it is better preserved, agrees with the protologue, and was annotated as "TYPUS" by Y. L. Chen and P. K. Chou on the specimen. The validating Latin diagnosis appeared in Chen and Chou (1979a).

Paratypes. CHINA. **Chongqing:** Chengkou, *T. L. Dai 100149* (PE [2]), *100280* (PE [2]), *100666* (PE); Fengjie, *C. Y. Chang 25036* (PE), *25459* (PE), *25999* (PE); Nanchuan, *G. F. Li 60889* (PE), *J. H. Xiong & Z. L. Zhou 92428* (PE). **Guizhou:** Tongzi, *Y. Tsiang 5141* (PE [2]). **Hubei:** Jianshi, *W. B. Lin 92* (PE); Xuanen, *H. J. Li 2760* (PE), *3271* (PE). **Sichuan:** Mt. Emei, *Y. L. Chen 33* (PE [2]), *H. L. Tsiang & S. S. Chang 30619* (PE), *31674* (PE), *G. H. Yang 54563* (PE), *55157* (PE), *56003* (PE), *57253* (PE).

Rhamnus kwangsiensis Y. L. Chen & P. K. Chou, sp. nov. *Rhamnus kwangsiensis* Y. L. Chen & P. K. Chou, Bull. Bot. Lab. N. E. Forest. Inst., Harbin 5: 77. 1979, nom. inval. TYPE: China. Guangxi: Guilin, Yanshan, s.d., *X. F. Deng 11111* (holotype, IBK).

Discussion. *X. F. Deng 11111* (IBK) is chosen as the holotype because it is better preserved, agrees with the protologue, and was annotated as "TYPUS" by Y. L. Chen and P. K. Chou on the specimen. The validating Latin diagnosis appeared in Chen and Chou (1979b).

Paratypes. CHINA. **Guangxi:** Guilin, Yanshan, *X. F. Deng 10948* (IBK), *Exped. Guangxi 4100* (PE [2]), *C. H. Tsoong 808475* (IBK, PE); Linggui, *Exped. Sino-German 341* (IBK); Yongfu, *S. Y. Li 6021* (IBK); Liangfeng, *Z. N. Deng 13578* (IBK); Dabu, *Z. N. Deng 13642* (IBK); Yangshuo, *Z. Z. Chen 53210* (IBK).

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Two New Species of *Machaerium* (Leguminosae) from Bahia and Southeastern Brazil

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ABSTRACT. Two new Brazilian species of *Machaerium* Pers. sect. *Oblonga* (Benth.) Taub. (Leguminosae) are described and illustrated. *Machaerium macaense* C. V. Mendonça, A. M. G. Azevedo & H. C. Lima is a tree species endemic to the Reserva Ecológica Macaé de Cima, an area of Atlantic forest in Rio de Janeiro State, Brazil. The species is closely similar to *M. nyctitans* (Vell.) Benth., from which it differs by its smooth bark, smaller leaflets, sunken secondary veins, narrower bracteoles, and smaller standard petal. It is also similar to *M. hatschbachii* Rudd, from which it differs by bark characters, the bracteoles that are shorter than the calyx, and its inconspicuous stigma. The second new species, *M. jobimianum* C. V. Mendonça & A. M. G. Azevedo, has a wider distribution than the first, in Minas Gerais, Espírito Santo, and Bahia states, occurring in Atlantic and mesophitic forests or as a pioneer in secondary vegetation. Its habit is a shrub, and it has been confused with *M. floridum* (Mart. ex Benth.) Ducke, from which it differs by its lustrous and glabrous leaflets, ovate bracteoles, and glabrous stamens. The species is also closely similar to *M. myrianthum* Spruce ex Benth., a vine or shrub from the Amazon Basin, which has wider paniculate inflorescences, a pandurate standard, and a longer stipe.

RESUMO. Duas novas espécies brasileiras de *Machaerium* Pers. sect. *Oblonga* (Benth.) Taub. (Leguminosae) são descritas e ilustradas. *Machaerium macaense* C. V. Mendonça, A. M. G. Azevedo & H. C. Lima é uma árvore endêmica da Reserva Ecológica de Macaé de Cima, uma área de Floresta Atlântica no estado do Rio de Janeiro, Brasil. A espécie é similar a *M. nyctitans* (Vell.) Benth., da qual difere pela casca lisa, folíolos menores, com nervuras secundárias imersas, bractéolas estreitas, e estandarte menor. Ela é também similar a *M. hatschbachii* Rudd, da qual difere pelas características da casca, bractéolas menores do que o cálice e estigma inconspícuo. A segunda espécie nova *M. jobimianum* C. V. Mendonça & A. M. G. Azevedo apresenta uma distribuição mais ampla do que a primeira nos estados de Minas Gerais, Espírito Santo e Bahia, ocorrendo nas Florestas Atlântica e mesofítica, ou na vegetação secundária como pioneiras. Seu hábito é arbustivo e tem sido confundida com *M. floridum* (Mart. ex Benth.) Ducke da qual se difere pelos folíolos lustrosos e glabros, bractéolas ovatas e estames glabros. A espécie é também similar a *M. myrianthum* Spruce ex Benth. uma liana ou arbusto da Amazônia, com inflorescências paniculadas, mais amplas, estandarte panduriforme e estilete mais longo.

Key words: Brazil, Dalbergieae, IUCN Red List, Leguminosae, *Machaerium*.

Machaerium Pers. (Leguminosae, Dalbergieae) is an amphi-Atlantic genus comprising approximately 130 species with all but one species (*M. lunatum* (L. f.) Ducke) confined to the Neotropics. Barretta-Kuipers (1971) first discussed a close relationship between *Machaerium* and *Dalbergia* L. f. This

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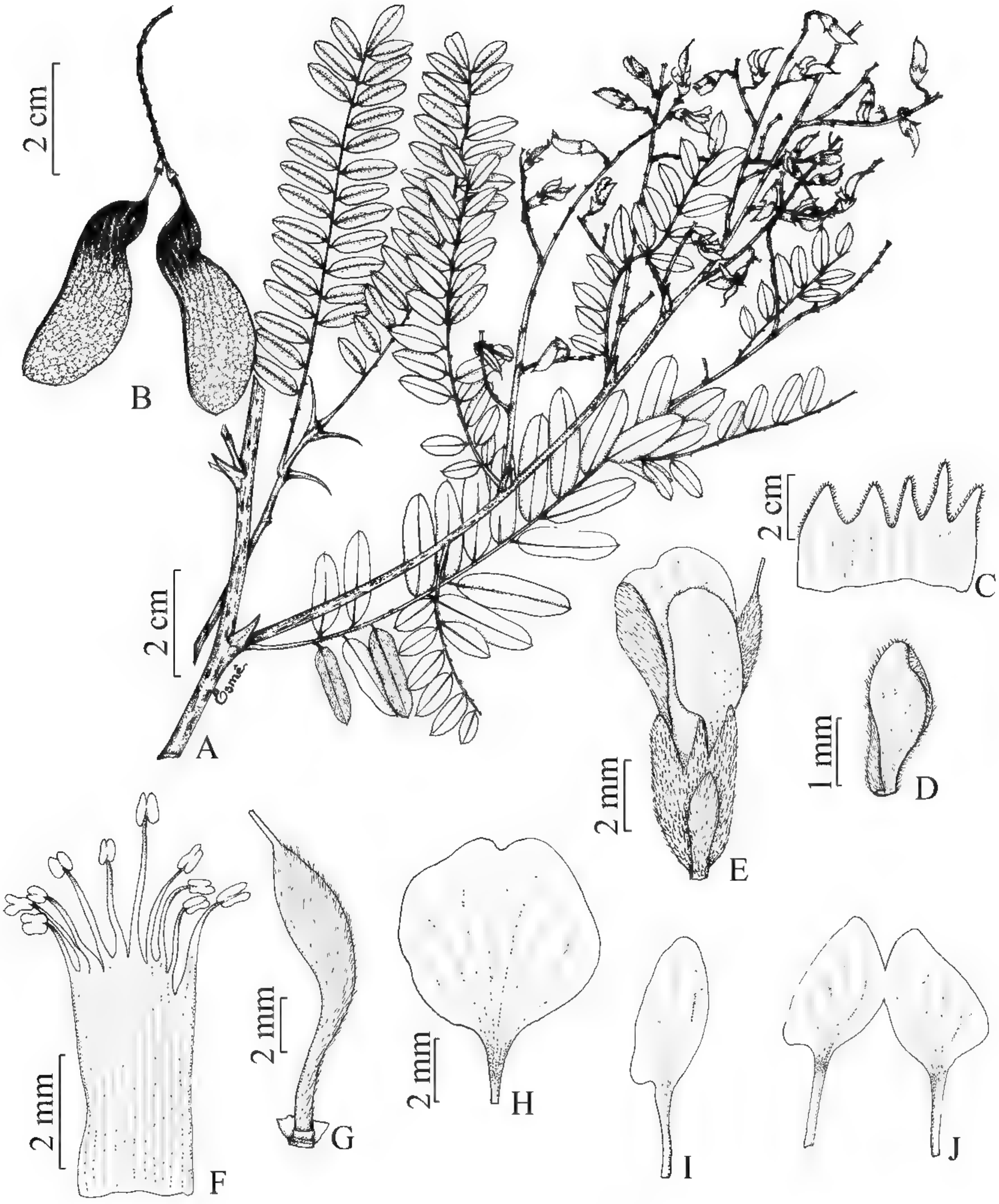

Figure 1. *Machaerium macaense* C. V. Mendonça, A. M. G. Azevedo & H. C. Lima. —A. Branches and inflorescences. —B. Fruit. —C. Calyx. —D. Bracteole. —E. Flower. —F. Androecium. —G. Gynoecium. —H. Standard petal. —I. Wing petal. —J. Keel petals. A, C–J drawn from the isotype *J. Caruso s.n.* (MBM); B drawn from the paratype *A. M. S. F. Vaz et al. 718* (NY).

relationship was later confirmed in molecular analyses by Lavin et al. (2001). More recent molecular analyses, however, still resolve *Machaerium* in the *Dalbergia* subclade, but closer to *Aeschynomene* L. subg. *Ochopodium* Vogel than to *Dalbergia* (Ribeiro et al., 2007). The species of *Machaerium* have been placed into five series by Bentham (1860) based on leaflet shape as well as venation and stipule texture. These groupings were given sectional status by Taubert (1891). Rudd (1987) found it convenient to recognize only four sections for the genus. During a taxonomic revision of *Machaerium* sect. *Oblonga* (Benth.) Taub. (Mendonça Filho et al., 2007), two undescribed species came to our attention and are described here as new.

1. Machaerium macaense C. V. Mendonça, A. M. G. Azevedo & H. C. Lima, sp. nov. TYPE: Brazil. Rio de Janeiro: Nova Friburgo, Reserva Ecológica de Macaé de Cima, 16 May 1990, *J. Caruso s.n.* (holotype, RB; isotypes, K, MBM, RB). Figure 1.

Haec species a *Machaerio nyctitante* (Vell.) Benth. cortex laevi, foliolis minoribus venis secundariis impressis, bracteolis angustioribus et vexillo minore, a *M. hatschbachii* Rudd bracteolis calyce brevioribus et stigmate inconspicuo differt.

Tree 12–20 m tall, 10–30 cm DBH. Leaves 5–11 cm; stipules caducous, spinose, 8–10 × ca. 2 mm; rachis fulvous-sericeous; leaflets 19 to 27(to 37),

oblong, 0.5–1.8 × 0.2–0.6 cm, petiolulate or sessile, glabrescent adaxially, white-sericeous abaxially, margin entire, apex obtuse to retuse, mucronulate, base cuneate, oblique; midvein prominent, secondary and tertiary venation sunken. Inflorescence an axillary or terminal panicle, 4–11.5 cm; bracts triangular, ca. 2.5 × 1 mm; peduncle white-tomentose to sericeous. Flowers 6–9 mm, subsessile; bracteoles lanceolate, ca. 3 × 1 mm; calyx 3–4 × 2–2.5 mm, fulvous-sericeous; standard ca. 6 × 4 mm, adaxially orbiculate, margins flavescent-tomentose, abaxially white-sericeous; petals lilac, keel petals 6–6.5 × 1.5–2 mm; wing petals ca. 6 × 2 mm; stamens 10, monadelphous to diadelphous (the vexillary stamen free), 5–7 mm, the free part of filaments 1.5–2 mm; style straight, 2.5–3 mm; ovary ca. 2.5 × 0.5 mm. Fruit a 1-seeded samara, 3.8–6 × 1.2–1.3 cm; seed chamber 1.3–1.5 × 0.8–1 cm.

Distribution and ecology. *Machaerium macaense* is found in southeastern Brazil, in Rio de Janeiro State; it grows in the upland Atlantic forest of the Serra dos Órgãos, at elevations between 900 and 1200 m.

IUCN Red List category. *Machaerium macaense* is assessed as Vulnerable (VU A4c; B1ab[iii]), according to IUCN Red List criteria (IUCN, 2001).

Phenology. The new species was collected in flower in March, May, June, and August, and in fruit in June, September, and October.

Etymology. The species epithet recognizes the new species' restricted distribution in the Reserva Ecológica de Macaé de Cima.

Discussion. According to the sectional classification of Taubert (1891), *Machaerium macaense* assigns to section *Oblonga*, based on the multifoliolate leaves, oblong leaflets, and spinescent stipule. It is similar to *M. nyctitans* (Vell.) Benth., differing from this taxon by its smooth bark, smaller leaflets (vs. 1.5–4 × 0.6–2 cm), sunken secondary veins, narrower bracteoles (vs. 3–5 × 0.5–1.5 mm), and smaller standard petal (vs. 6.4–10 × 5–8 mm). The species is also similar to *M. hatschbachii* Rudd, from which it differs in bark characters, the bracteoles that are shorter than the calyx (vs. as long as the calyx), and the inconspicuous stigma (vs. capitate).

Paratypes. BRAZIL. **Rio de Janeiro:** Nova Friburgo, Res. Ecol. de Macaé de Cima, *H. C. de Lima & J. Caruso 3830* (F, P, RB, U), *H. C. de Lima, F. C. Garcia & G. Laurentino 5024* (MO, RB), *C. M. B. Correia, S. V. A. Pessoa, J. Caruso, L. C. Silva & J. C. Silva 99* (CEPEC, NY, RB), *A. M. S. F. Vaz, L. Sylvestre, C. M. Vieira & L. C. Silva 718* (NY, RB), *C. V. Mendonça & E. S. Câmara 616* (UEC).

2. Machaerium jobimianum C. V. Mendonça & A. M. G. Azevedo, sp. nov. TYPE: Brazil. Espírito Santo: Linhares, Reserva Florestal da Vale, Km 2 of rd. Bicuíba, 19 Sep. 2001, *D. A. Foli 4060* (holotype, CVRD; isotype, MO). Figure 2.

Haec species a *Machaerio florido* (Mart. ex Benth.) Ducke foliolis pluribus crebrioribus pagina adaxiali nitida, bracteolis ovatis brevioribus, calyce breviore et vagina staminali glabra, a *M. myriantho* Spruce ex Benth. inflorescentia angustiore, vexillo base attenuato et fructus stipite breviore differt.

Shrubs or small trees to 3 m tall, 5–10 cm DBH. Leaves 4–7.5 cm; stipules caducous, triangular, striate, spinose, 4–4.5 × 1.3–1.5 mm; rachis ferruginous-puberulent; leaflets 27 to 41, oblong, 0.6–1.3 × 0.2–0.4 cm, petiolulate or sessile, glabrous, lustrous adaxially, canescent to sericeous abaxially, margin entire, apex obtuse to retuse, base cuneate, oblique; midvein prominent, secondary venation brochidodromous. Inflorescence an axillary or terminal raceme or panicle, 5–14 cm; bracts caducous; peduncle ferruginous-tomentose. Flowers 6–7 mm, subsessile; bracteoles ovate, 0.7–1 × 0.5–1 mm; calyx ca. 2 × 1.5–2 mm, ferruginous-sericeous to tomentose; petals cream, standard 5–6 × 4–4.5 mm, orbiculate, the adaxial margins ferruginous-tomentose, the abaxial surface ferruginous-sericeous; keel petals 5–5.5 × ca. 2 mm; wing petals 5–6 × 1.5–2 mm; stamens 10, monadelphous, 3–4.5 mm, the free part of filaments 1.5–2 mm; style straight, 1.5–2 mm; ovary ca. 2 × 0.5 mm. Fruit a 1-seeded samara, 4–4.5 × ca. 1 cm; seed chamber ca. 1.2 × 0.8 cm.

Distribution and ecology. *Machaerium jobimianum* is found in southeastern and northeastern Brazil, in Minas Gerais, Espírito Santo, and Bahia states; it grows in lowland Atlantic and mesophitic forests, or as a pioneer in secondary vegetation.

IUCN Red List category. *Machaerium jobimianum* is assessed here as Data Deficient (DD) because insufficient information is available to apply IUCN Red List criteria (IUCN, 2001).

Phenology. The new species was collected in flower in August and September and in fruit in September.

Etymology. The new species is named in honor of the Brazilian popular poet, musician, and environmental activist Antônio Carlos Jobim (1927–1994).

Discussion. *Machaerium jobimianum* is best assigned to *Machaerium* sect. *Oblonga* based on its multifoliolate leaves, oblong leaflets, and spinescent

Figure 2. *Machaerium jobimianum* C. V. Mendonça & A. M. G. Azevedo. —A. Branches and inflorescences. —B. Fruit. —C. Calyx. —D. Bracteole. —E. Flower. —F. Androecium. —G. Gynoecium. —H. Standard petal. —I. Wing petal. —J. Keel petals. A, C–J drawn from the paratype *L. A. M. Silva et al. 189* (CEPEC); B drawn from the paratype *C. V. Mendonça & D. A. Folli 599* (UEC).

stipules. It is closely similar to *M. floridum* (Mart. ex Benth.) Ducke, but differs by its lustrous adaxial leaflet surface, its leaves with more leaflets (vs. 17 to 25 in *M. floridum*) that are more closely spaced than in *M. floridum*, its shorter ovate bracteoles and calyx (vs. 1.5–2.5 mm and 2.5–3 mm), and the glabrous marginal staminal sheath (vs. ferruginous-tomentose). The species also resembles *M. myrianthum* Spruce ex Benth., a vine or shrub from the Amazon Basin, which has paniculate inflorescences that are wider (up to 15 cm), a pandurate standard petal, and a longer fruit stipe (to 6–7 mm).

Paratypes. BRAZIL. **Bahia:** Macarani, Km 18 of rd. from Maiquinque to Itapetinga, *L. A. M. Silva, T. S. Santos & J. L. Lage 189* (CEPEC). **Espírito Santo:** Linhares, Reserva Flor. Com. Vale, Km 2 of rd. Santa Terezinha, *C. V. Mendonça & D. A. Folli 599* (CVRD, UEC). **Minas Gerais:** Águas Vermelhas, *C. V. Mendonça & R. Belinello 625* (UEC).

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Five New Species of South American *Gentianella* (Gentianaceae)

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Abstract. Five new species of *Gentianella* Moench (Gentianaceae) are described from western South America. *Gentianella decemnectaria* J. S. Pringle, from Peru, is characterized by decumbent stems and nearly rotate corollas with 10 nectaries per corolla. *Gentianella pluvialis* J. S. Pringle, from Bolivia, is similar to *G. florida* (Griseb.) Holub, differing in its larger flowers with bright yellow corollas. *Gentianella pyrostelium* J. S. Pringle, from Peru, is characterized by its columnar habit and red and yellow, scarcely opening corollas. *Gentianella rugicalyx* J. S. Pringle, from Peru, differs from *G. paludicola* (Gilg) J. S. Pringle in its wider, abruptly acute calyx lobes and corolla tube that widens more gradually, and from *G. persquarrosa* (Reimers) J. S. Pringle in its leafier stems and glabrous corollas. *Gentianella sanchezii* J. S. Pringle, from Peru, is characterized by slender, clustered stems arising from a persistent rosette, pedicels mostly longer than the internodes, and widely funnelform, purplish pink corollas.

Resumen. Se describen cinco nuevas especies de *Gentianella* Moench (Gentianaceae) del oeste de América del Sur. *Gentianella decemnectaria* J. S. Pringle, del Perú, se caracteriza por los tallos decumbentes y las corolas casi rotáceas las cuales llevan 10 nectarios. *Gentianella pluvialis* J. S. Pringle, de Bolivia, se parece a *G. florida* (Griseb.) Holub pero se diferencia por las flores más grandes y las corolas amarillas intensas. *Gentianella pyrostelium* J. S. Pringle, del Perú, se caracteriza por el hábito columnar y las corolas rojas y amarillas las cuales apenas se abren. *Gentianella rugicalyx* J. S. Pringle, del Perú, se diferencia de *G. paludicola* (Gilg) J. S. Pringle por los lóbulos del cáliz más anchos y abruptamente agudos y por el tubo de la corola el cual se ensancha más gradualmente, y de *G. persquarrosa* (Reimers) J. S. Pringle por los tallos más hojosos y las corolas glabras. *Gentianella sanchezii* J. S. Pringle, del Perú, se caracteriza por los tallos delgados agrupados sobre la roseta persistente, los pedicelos en su mayoría más largos que los entrenudos, y las corolas anchamente infundibuliformes lilacino-rosáceas.

Key words: Bolivia, Gentianaceae, *Gentianella*, IUCN Red List, Peru.

The genus *Gentianella* Moench (Gentianaceae) is represented by many diverse species in the Andes of South America, where new species continue to be discovered. Consequently, five new species are described here.

Phenology. All known specimens of the respective species are cited below, and all collections consist of or include plants in flower. The dates of collection provide the only information on phenology.

IUCN Red List categories. Information on distribution is limited to that on the labels, and does not suffice to indicate the local abundance or the extent of the ranges of the five new species of *Gentianella*. Data are therefore deficient for recommended listing according to IUCN Red List criteria (IUCN, 2001).

1. Gentianella decemnectaria J. S. Pringle, sp. nov. TYPE: Peru. Amazonas: Prov. Chachapoyas, Distr. Leymebamba, ruta a Laguna de Los Cóndores, entre Toronjil y Lajasbamba, borde de camino, 15 Aug. 1998, *V. Quipuscoa S., A. Sagástegui A., S. Leiva G. & M. Bejarano C. 1190* (holotype, HAM; isotypes, F not seen, HAO not seen). Figure 1.

Inter *Gentianellas* andinas caulibus decumbentibus proximaliter repentibus, corollis subrotatis violaceis lobis rhombeo-obovatis quam tubo circa 3.6-plo longioribus et nectariis binatis distinguenda.

Synoecious; plants herbaceous, ± long-lived monocarpic or perhaps perennial; stems strongly decumbent and ± vinelike, proximally 1–4 mm diam., branched, probably to 6–10 dm (as estimated from available specimens); adventitious roots developing from older portions. Leaves medium green, thin-textured; proximal leaves crowded, only scars and persistent bases present at flowering time; leaves gradually more widely spaced distally (internodes 2–10 mm near base of stem, 20–60 mm near inflorescence); midstem and distal leaves many at flowering time, elliptic to lanceolate or ovate, 15–50 × 4–20 mm, 5- to 9-nerved, margins smooth and flat, bases not pseudopetiolate, those of midstem leaves connate-sheathing to 1 mm, those of distal leaves free, apices acute to short-acuminate. Inflorescence an open thyrse, racemoid except for a few 1- to 6-

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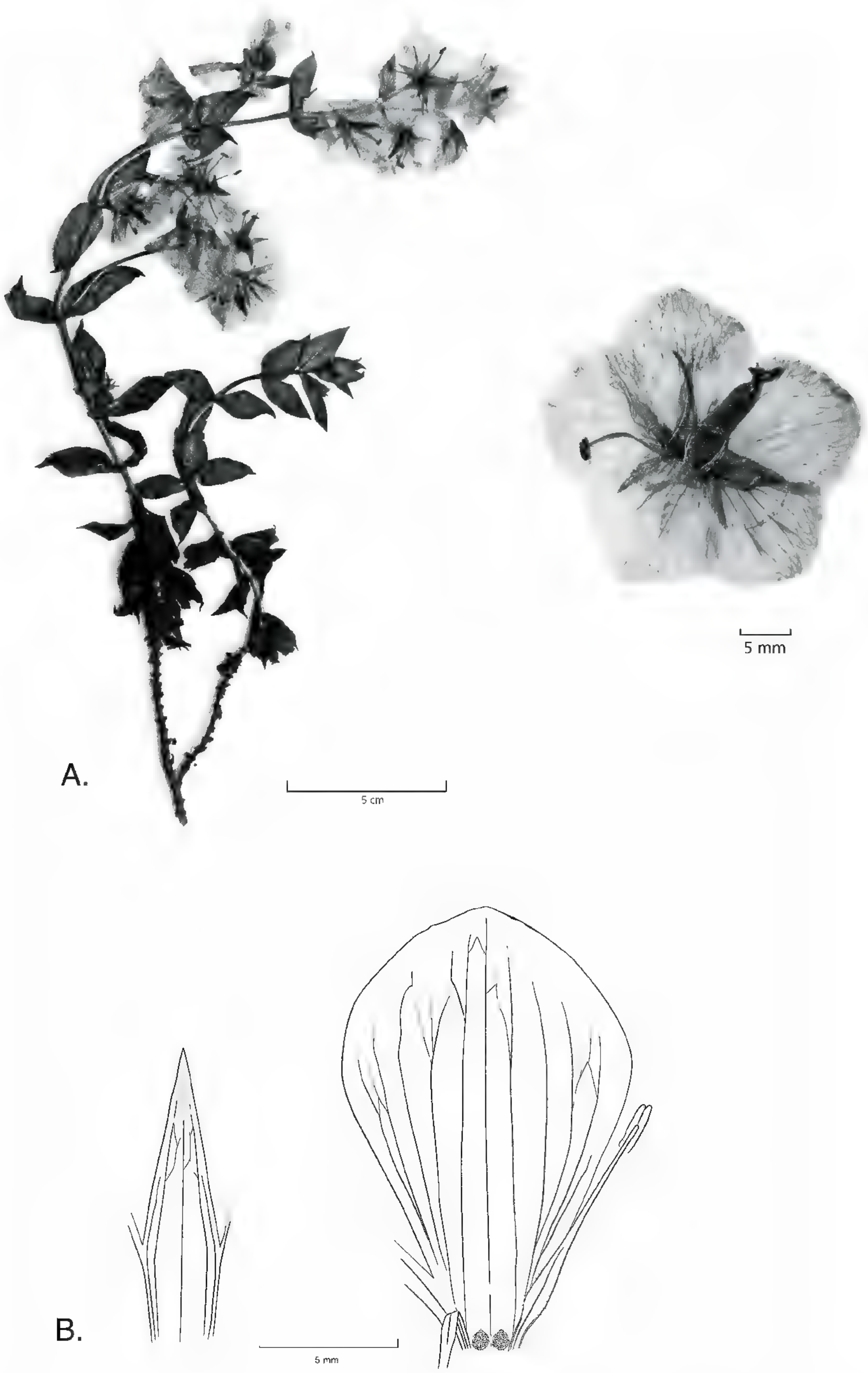


Figure 1. *Gentianella decemnectaria* J. S. Pringle. —A. Holotype, *Quipuscoa S. et al. 1190*: left, flowering stem; right, flower. —B. Details of flower, drawn from the same specimen: left, calyx lobe, abaxial view; right, corolla lobe and stamen, adaxial view.

flowered branches; flowers 12 to ca. 50 per primary stem; pedicels 8–35 mm on main axis, shorter on branches. Calyx 8–14 mm, midveins low-ridged, tube 1.8–4 mm; calyx lobes lanceolate-triangular, (3–)4–9 × 2–4.2 mm (width at base), margins smooth, apices acute; adaxial colleters at base of calyx few and minute or none; corolla lilac or pale violet, nearly rotate, (10–)16–22 mm long when closed, opening to

(22–)30–40 mm diam.; corolla lobes elliptic-rhombic to rhombic-obovate, (10–)12–18 × (5–)10–13 mm, 3.5–4.5× as long as tube, 0.9–1.5× as long as wide, widest at 0.5–0.7× their length, apices obtuse; adaxial trichomes absent; nectaries 10, 1 on each side of each petal midvein, forming 5 pairs between adnate portions of filaments, 1–2 × 0.7–1 mm; filaments inserted at 0.3–0.5× height of corolla tube, 8–10 mm, papillose-scabridulous proximally on both surfaces but more strongly so adaxially, smooth distally, papillose-ciliolate along margins for much of length; anthers purple, 1.4–2.5 mm; ovary with stipe ca. 1 mm at anthesis; stigmas elliptic-oblong, ca. 1.8 × 1.4 mm. Capsule not seen.

Habitat and distribution. All specimens of *Gentianella decemnectaria* were collected at 3120–3500 m. Otherwise, information on the habitat of this species is limited to that on the herbarium labels, quoted here.

Etymology. The specific epithet *decemnectaria* refers to the 10 nectaries on each corolla.

Discussion. Hagen and Kadereit (2001, 2002) characterized *Gentianella*, subject to the exclusion of certain Asiatic species as noted below, as having epipetalous nectaries isomerous with the corolla lobes, one proximal to each lobe. Molecular evidence from their studies indicated that the few species with paired nectaries that had until that time been retained in *Gentianella*, known only from Asia, should be excluded from the genus. The most likely affinities of those species were considered to be with *Comastoma* (Wettst.) Toyok. and *Lomatogonium* A. Braun. With those species excluded, *Gentianella* appeared from this molecular evidence to be monophyletic. Except in *G. decemnectaria*, in all South American species of *Gentianella* examined to date the number of nectaries per corolla equals the number of lobes, normally five. Although *G. decemnectaria* has two nectaries per petal, one on each side of the midvein, nothing about its vegetative or floral morphology suggests a closer relationship to *Comastoma* or *Lomatogonium*, neither of which occurs in South America, or to any group other than Andean *Gentianella*.

Although depth of corolla lobing has been emphasized in some proposals to divide *Gentianella* into sections or segregate genera, lobing is highly variable among the South American species and sometimes differs among otherwise similar species. Even among South American species, however, corollas so nearly rotate constitute another unusual feature of *G. decemnectaria*. The lobes diverge widely from the summit of the proportionately short corolla tube. In herbarium specimens the corolla lobes are often spread as they would be, for example, in *Catharanthus roseus* (L.) G. Don rather than being pressed in an ascending position. The corolla lobes are more or less rhombic; that is, the margins, rather than forming a continuous curve from near the base to the apex, are nearly straight to slightly concave proximally, abruptly curved near mid-length, and only slightly convex distally. Although the filaments are generally wider distally than proximally throughout *Gentianella*, the relatively long filaments of *G. decemnectaria* taper especially strongly. The minutely papillose-ciliolate margins and proximally papillose-scabridulous surfaces of the filaments are perhaps unique among Andean *Gentianella* species.

The habit of *Gentianella decemnectaria* is unusual for *Gentianella* in that the currently leafy portion of the stem terminates a long, sprawling older portion. The stems elongate for some time before flowering, and the older portions become prostrate or nearly so. Slender adventitious roots arise from some of the many closely spaced proximal nodes. Fragments of a pleurocarpous moss attached to *Boeke 2017* indicate that the stems elongated through a loose, mossy substrate. At most of the nodes, the opposite leaves are basally connate-sheathing. Distally the sheaths are less well developed, and near and in the inflorescences they are absent, not even a transverse ridge connecting the leaf bases.

In its decumbent stems, the size and shape of its leaves, the lobing of its calyx, and the shape and venation of its calyx lobes, *Gentianella decemnectaria* is similar to *G. kuntzei* (Gilg) T. N. Ho & S. W. Liu, of Bolivia. *Gentianella kuntzei* differs in that its pedicels are 5–15 mm, shorter and more slender than those of *G. decemnectaria*; the corolla, although deeply lobed, is only 12–18 mm when closed, with narrowly obovate lobes; the filaments are smooth; and there are only five nectaries per corolla.

In its crowded proximal leaves of which at most only remnants of the basal sheaths remain at flowering time, and in some aspects of its calyx and corolla morphology, *Gentianella decemnectaria* is similar to *G. euphorbiifolia* Fabris. *Gentianella decemnectaria* differs from *G. euphorbiifolia* in its large, paired nectaries, those of *G. euphorbiifolia* being ca. 0.8 mm, one proximal to each corolla lobe. Also, *G. decemnectaria* does not have the unusual floral trichomes of *G. euphorbiifolia*, in which a few relatively long, firm trichomes are borne at the summit of a lateral flange on each side of the adnate portions of the stamens rather than on the adaxial corolla surface. In the size, lobing, and color

of its corollas, *G. decemnectaria* is similar to *G. speciosissima* (Gilg) Zarucchi, which is likewise known from the vicinity of Chachapoyas, but that species differs distinctly in its stiffly erect stem and linear-lanceolate leaves, of which the basal and proximal cauline are the largest, persistent at flowering time.

Paratypes. PERU. **Amazonas:** Prov. Chachapoyas, Lajasbamba, jalca, 27 June 1977, *J. D. Boeke 2017* (HAM, NY, U); Prov. Chachapoyas, ca. 4 km past summit at Calla-Calla, rd. Balsas to Leimebamba (27 km from Leimebamba), 6°48′S, 77°50′W, wet cloud forest, 4 Feb. 1985, *B. Stein & C. Todzia 2076* (HAM, MO). **Piura:** Prov. Huancabamba, "Las Huarinjas," Laguna de Shimbe, 13 Jan. 1988, *C. Díaz, H. Osores, V. Vásquez & M. Oponte 2662* (HAM, MO). **San Martín:** Prov. Huallaga, Distr. Saposoa, alrededores de la laguna La Artesa, 23 Aug. 2001, *V. Quipuscoa S., M. Vílchez T., M. Kamp & K. Edmunds 2605* (F not seen, HAM, HAO not seen).

2. Gentianella pluvialis J. S. Pringle, sp. nov. TYPE: Bolivia. Santa Cruz: Prov. [Manuel María] Caballero, Siberia, tramo de 1–2 km subiendo al E por arriba de la escuela, 17°49′S, 64°45′W, ladera de exposición SE, arbustos ralos y pajonale con gramíneas, 24 July 1996, *I. G. Vargas C. & B. Cruz G. 4938* (holotype, HAM; isotypes, NY, USZ not seen). Figure 2.

Gentianellae floridae (Griseb.) Holub affinis, sed ab ea floribus majoribus et corollis clare flavis differens.

Dioecious or gynodioecious (see discussion below); plants herbaceous, perennial, height 25–45 cm including inflorescence; caudex stout (ca. 16 mm diam. in type), covered with remains of old leaf bases; stems few, clustered, stiffly erect, 4–9 mm diam. near base. Leaves light green, only midvein prominent, bases not connate-sheathing but connected by a low transverse ridge except sometimes at most distal nodes, margins smooth and flat, apices acute; basal and near-basal leaves crowded, strongly ascending, elliptic-lanceolate, mostly 5–9 cm × 3–8 mm, pseudopetiolate; leaves gradually smaller and less closely spaced distally (median and distal internodes 5–11 cm), appressed-ascending, lanceolate or oblong-lanceolate, not pseudopetiolate. Inflorescence a thyrse, terminal cymules umbelloid; flowers 10 to 50 per stem; pedicels 10–35 mm. Flowers erect; calyx 9–15 mm, tube 4.5–6.5 mm, ridged along commissural veins, sinuses varying in depth on same calyx; calyx lobes triangular, 4.5–9.5 × 2.3–4 mm (width at base), margins smooth, apices acute; colleters at and near base of calyx few, minute; corolla bright yellow ("intenso muy vistoso," in sched., type), campanulate, 15–25 mm long, probably opening to ca. 1 cm diam.; corolla lobes obovate, 10–16 × 5–9 mm, 2.5–3× as long as tube and 1.6–2× as long as wide, widest at 0.5–0.6× their length, margins minutely erose toward apex, apices obtuse to rounded; a few scattered purple-tipped trichomes ca. 0.25 mm long on adaxial surface of corolla tube between stamen insertion and sinuses; nectaries 5, ca. 1.5 × 1.2 mm; pistillate flowers with nonfunctional anthers, ca. 1 mm, subsessile at ca. 0.4× height of corolla tube; staminate plants not seen; ovary sessile; stigmas deltoid-ovate, 2–2.5 × 2–2.5 mm, margins revolute. Capsule not seen.

Habitat and distribution. The holotype of the name *Gentianella pluvialis* was collected at 3000–3050 m and the paratype at 2700 m. Otherwise, information on the habitat of this species is limited to that on the herbarium labels, quoted here.

Vernacular names and etymology. Vernacular names are given on the label of the holotype as "para thica" and "flor de la lluvia." The specific epithet of the new species is the Latin translation of both the indigenous and the Spanish names.

Discussion. At lengths to 2.5 mm, the stigmas of the functional pistils of *Gentianella pluvialis* are two or more times as large as those of most other South American *Gentianella* species. The nectaries to 1.5 mm are also large for the genus.

Although in most species of *Gentianella* all plants produce bisexual flowers only, Gilg (1916), Juárez de Varela (1997), and Filippa and Barboza (2006a, 2006b) have reported additional breeding systems in several Bolivian and Argentinian species. According to those authors, *G. chrysantha* (Gilg) T. N. Ho & S. W. Liu, *G. florida* (Griseb.) Holub, and probably *G. benedictae* (Gilg) Fabris and *G. bromifolia* (Griseb.) T. N. Ho & S. W. Liu are gynodioecious, with some plants producing bisexual flowers and other plants producing pistillate flowers only; *G. thiosphaera* (Gilg) Holub (including *Gentiana comparapana* Gilg and *G. macroclada* Gilg) is trimonoecious, with bisexual, pistillate, and staminate flowers on the same plants; *Gentianella fabrisii* Filippa & Barboza, *G. imberbis* (Griseb.) Filippa & Barboza, *G. kurtzii* (Gilg) Fabris, *G. multiflora* (Griseb.) Fabris, and *G. myriantha* (Gilg) Holub are gynomonoecious, with both bisexual and pistillate flowers on the same plants; and *G. bangii* (Gilg) Fabris ex T. N. Ho & S. W. Liu appears to be andromonoecious, with individual plants producing both bisexual and staminate flowers. Plants of southern Ecuador, provisionally included in *G. dacrydioides* (Gilg) Weaver & Rüdenberg, and a new species from northern Peru, both under study at the time of this

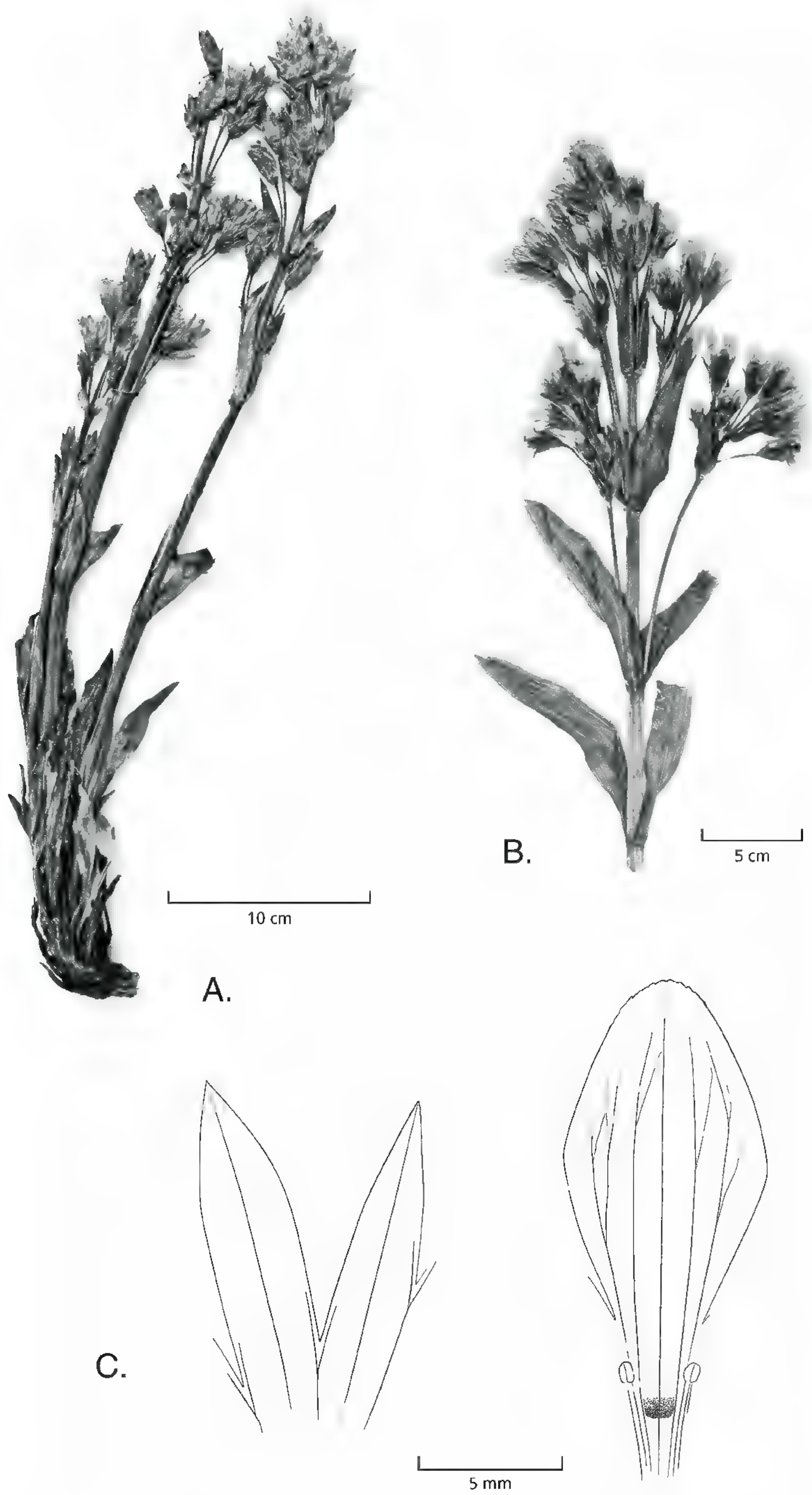


Figure 2. *Gentianella pluvialis* J. S. Pringle. —A. Holotype, *Vargas C. & Cruz G. 4938*: left, plant; right, portion of inflorescence. —B. Details of flower, drawn from the same specimen: left, two calyx lobes, abaxial view; right, corolla lobe and sterile stamens, adaxial view.

writing, produce unisexual pistillate flowers and appear likely to be gynodioecious. Gynomonoecy and, less often, gynodioecy have also been reported in *Gentianella* species in Australia and New Zealand (Glenny, 2004). *Gentianella pluvialis* is morphologically most similar to the gynodioecious Argentinian and Bolivian species, but because it is known only from the collections cited in this paper, neither of

which includes plants with functional stamens, it is not known whether this new species is strictly dioecious or gynodioecious.

Gentianella pluvialis is probably closely related to *G. florida* (provisionally including *Gentiana tatei* Rusby and *G. tradescantiifolia* Britton ex Rusby), which is relatively widely distributed in Bolivia and northern Argentina. Both species are perennials with a stout caudex and clustered, erect stems, and in both the corolla lobes are longer than the tube. From *G. florida*, *G. pluvialis* differs most conspicuously in its longer pedicels, larger flowers, and bright yellow corollas. Although in *G. florida* the pedicels at the proximal cyme divisions are sometimes as long as 30 mm, most of the pedicels of that species are 2–20 mm, with many of the distal pedicels being less than 10 mm. The calyces of *G. florida* are 3–7.5 mm, with the commissural veins not ridged, and the corollas are 7–15 mm, white or yellowish white when fresh.

Gentianella thiosphaera and *G. bangii* (including *Gentiana totorensis* Gilg) are monocarpic, with a single stem and a taproot, with no caudex development and no basal leaves at flowering time, and differ from *G. pluvialis* in their lower stature and more slender stems. The corollas of *G. bangii* are 11–16 mm, white or yellowish white, and the corolla tube of *G. thiosphaera* is longer than the lobes. *Gentianella benedictae*, although likewise tall and stout-stemmed, differs from *G. pluvialis* in its widely elliptic to ovate leaves, the proximal leaves having a pseudopetiole often longer than the blade; dense, subglobose clusters of flowers terminating the stem and on axillary peduncles to 15 cm; and pale yellow corollas with the tube longer than the lobes.

In all other gynodioecious and trimonoecious species of *Gentianella* known from South America, and in the gynomonoecious species *G. imberbis* and *G. multiflora*, the corolla tube is as long as or longer than the lobes. All of the gynomonoecious species except *G. multiflora* also differ in having few-flowered inflorescences and blue to lilac corollas.

Paratype. BOLIVIA. **Cochabamba:** Prov. Carrasco, Montepunco, entrando por los Yungas, bosque arbustivo bajo, en zona nubosa, 18 Oct. 1984, *S. G. Beck 8936* (HAM, LPB not seen).

3. Gentianella pyrostelium J. S. Pringle, sp. nov. TYPE: Peru. La Libertad: Prov. Bolívar, ascenso ao Nevado de Cajamarquilla, 7°08′S, 77°42′W, 10 Nov. 2001, *I. Sánchez V., M. Dillon & G. Iberico V. 11175* (holotype, HAM; isotypes, CPUN not seen, F not seen). Figure 3.

Inter *Gentianellas* andinas habitu columnari caule solitario erecto, floribus in cymulis et solitariis in axillas fere omnes rosulam supra dispositis, corollis flavis abaxialiter rubrosuffusis vix aperientibus et capsulis anguste alatis distinguenda.

Synoecious; plants apparently monocarpic; taproot persistent; stem 1, erect, 1–2 dm including inflorescence, 4–6 mm diam. near base, simple except for short branches in inflorescence; remains of numerous leaf bases present below rosette at flowering time. Leaves dark green, margins slightly thickened, smooth; bases not pseudopetiolate, neither connate-sheathing nor connected by ridge; rosette of 10 to 20 basal and near-basal leaves present at flowering time; first 1 or 2 internodes above rosette 2–4 cm, longer than leaves, internodes gradually shorter distally; rosette leaves narrowly obovate to elliptic, 10–35 × 7–12 mm, 3- to 7-nerved, apices obtuse; cauline leaves elliptic to narrowly ovate, leaves gradually smaller distally, more acute. Flowers many, ascending, in all or most axils above near-basal, flowers in proximal axils sometimes in cymules of 3 to 5 on strongly ascending branches 1–3 cm long, those in distal axils solitary or in subsessile cymules of 2 or 3; pedicels 2–10 mm. Calyx campanulate, 7–9 mm, neither tube nor lobes keeled or conspicuously ridged; calyx lobes ovate-triangular to lanceolate-triangular, 3–4 × 1.5–4 mm (width at base) (outermost lobes wider than inner), margins smooth, apices acute; adaxial colleters at base of calyx many, dense; corolla yellow, abaxially much suffused with red, especially distally and toward edges of lobes first exposed in bud, narrowly urceolate, remaining closed or opening only slightly, 13–17 mm; corolla lobes obovate, 6–9 × 4.5–6 mm, 1.4–1.5× as long as tube and 1.3–1.5× as long as wide but somewhat hooded, especially toward side concealed in bud, therefore appearing narrower, rounded at apex; adaxial trichomes absent; nectaries 5, ca. 0.8 × 0.8 mm; filaments inserted at ca. 0.45× height of corolla tube, 6–7 mm; anthers probably pale yellow with purple suffusion when fresh, ca. 1.6 mm; ovary sessile; stigmas semicircular, ca. 1 × 1.2 mm. Capsule with distal 1/5 winged along carpel midveins, wings ca. 0.25 mm wide; sutures with a narrower wing from base to apex.

Habitat and distribution. The type of the name *Gentianella pyrostelium* was collected at 3000 m. Otherwise, information on the habitat of this species is limited to that on the herbarium label, quoted above.

Etymology. The specific epithet *pyrostelium*, inspired by Exodus 13:21–22, means "a little pillar of fire." Being a noun in apposition rather than an

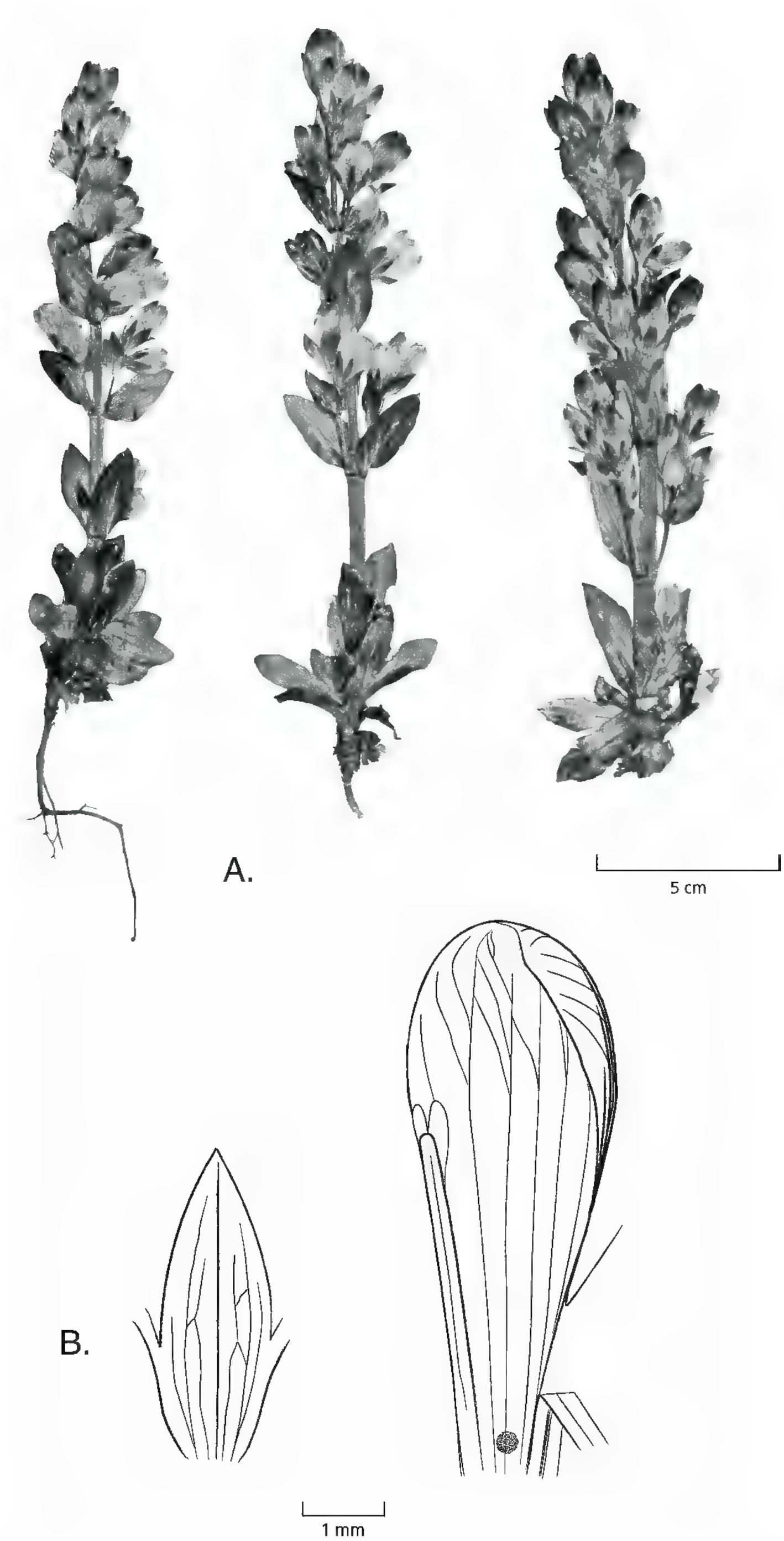


Figure 3. *Gentianella pyrostelium* J. S. Pringle. —A. Holotype, *Sánchez V. et al. 11175*, plants. —B. Details of flower, drawn from the same specimen: left, calyx lobe, abaxial view; right, corolla lobe and stamens, adaxial view.

adjective, it retains the Greek diminutive suffix *-ium* rather than ending in *-a*.

Discussion. Among the many Peruvian species of *Gentianella*, the combination of basal leaves in a persistent rosette, a solitary main stem that is erect and proportionately stout for the height of the plant, a columnar inflorescence, and deeply lobed, red-and-yellow corollas that remain closed or nearly so gives *G. pyrostelium* a distinctive aspect. Its distally

narrowly winged capsule is perhaps unique among the Andean species of *Gentianella*.

Several other species with corollas that are yellow with red suffusions or longitudinal stripes along the exposed outer edges of the lobes, and that remain closed or nearly closed, are native from Ecuador south to Bolivia. The corollas of *Gentianella pyrostelium* appear to be most similar in size, shape, lobing, and color to those of *G. brunneotincta* (Gilg) J. S. Pringle, of northern and central Peru, and *G. hirculus* (Griseb.) Fabris, of Ecuador. Plants of those species are likewise low in stature, but have clustered, strongly decumbent stems bearing only one to four flowers each. In *G. brunneotincta* most of the pedicels are longer than the flowers. *Gentianella hirculus* differs further in its caespitose or patch-forming habit, with several to many flowering and vegetative stems present concurrently. The corollas of *G. hyssopifolia* (Kunth) Fabris, of Ecuador, are also similar, but differ in the presence of adaxial trichomes. Plants of *G. hyssopifolia* are usually 1.5–5 dm, with the distal internodes much longer than the proximal. Its leaves are linear to narrowly lanceolate, spreading arcuately, and its inflorescence is corymboid or umbelloid. *Gentianella raimondiana* (Wedd.) J. S. Pringle, of northern Peru, is likewise taller, with linear leaves to 8 cm, with the base connate-sheathing 2–4 mm long. In *G. erythrochrysea* (Gilg) Fabris, of Bolivia and Argentina, the pedicels are 1–5 cm, forming an open inflorescence, and the corollas are 20–30 mm.

4. Gentianella rugicalyx J. S. Pringle, sp. nov. TYPE: Peru. La Libertad: Prov. Santiago de Chuco, Jalca de Coipín, 16 June 1984, *A. Sagástegui A., J. Mostacero L. & M. Diestra Q. 11973* (holotype, HAM; isotypes, HUT not seen, MO, NY). Figure 4.

Gentianellae paludicolae (Gilg) J. S. Pringle et *G. persquarrosae* (Reimers) J. S. Pringle similis, sed a *G. paludicola* calycum lobis oblongis ad ovato-oblongis non acuminatis et corollae tubo gradatim dilatato, a *G. persquarrosa* foliis pluribus et corollis intus imberbis differens.

Synoecious. Plants tufted, perennial or at least flowering over a long period; stems several to many, strongly decumbent, 1–12 cm below terminal peduncle, simple or with a few short branches. Basal leaves narrowly spatulate-oblanceolate, 8–18 × 1.5–3 mm; cauline leaves in 1 to 5 pairs or occasionally more on longer stems, gradually decreasing in size distally, distal leaves mostly spatulate-elliptic, 5–12 × 1–2.5 mm; 2 distal leaf-pairs occasionally closely spaced, forming a near-whorl; all leaves obtuse; largest leaves short-pseudopetiolate, others not pseudopetiolate, bases scarcely connate-sheathing or proximal pairs with sheaths to 1.5 mm, margins smooth, apices acute. Flowers solitary, those on branches smaller and later than those terminating main axis; peduncles 3.5–6(–10) cm on main axis, shorter on branches. Calyx 6–10 mm, midveins and commissural veins ridged; calyx lobes oblong to ovate-oblong, 2.5–4.5 × 1–2.5 mm (width at base), 1.6–2× as long as tube, obtuse to acute, with ± cartilaginous margins ca. 0.1 mm wide; adaxial colleters at base of calyx none; corolla widely campanulate, 10–17 mm, white, suffused with purple toward outer margin of lobes and along veins and sometimes less strongly so near base of lobes; corolla lobes elliptic-rhombic, 7–9 × 3–6 mm, 1.5–2.2× as long as tube, 1.6–2× as long as wide, apex rounded to subacute; adaxial trichomes absent; nectaries 5, inconspicuous, ca. 0.6 × 0.2 mm; filaments inserted at ca. 0.5× height of corolla tube, 4.5–7 mm; anthers 1.8–2.2 mm; ovary with indistinct stipe ca. 0.5 mm at anthesis; stigmas nearly semicircular, ca. 1 × 1 mm. Capsule not seen.

Habitat and distribution. All known specimens of *Gentianella rugicalyx* were collected at 3960–4150 m. Otherwise, information on the habitat of this species is limited to that on the herbarium labels, quoted here.

Etymology. The calyces of *Gentianella rugicalyx* are to varying degrees transversely wrinkled near and below the bases of the lobes, forming a "washboard" surface for which the species is named. In pressed specimens, this wrinkling is represented by kinks in the midveins as shown in Figure 4B.

Discussion. In combining low stature with strongly decumbent, mostly branched stems, *Gentianella rugicalyx* is similar in habit to *G. paludicola* (Gilg) J. S. Pringle and *G. persquarrosa* (Reimers) J. S. Pringle. *Gentianella paludicola*, of Ancash Department, Peru, differs in its acute leaves; lanceolate, acuminate calyx lobes proportionately narrower than those of *G. rugicalyx*; and more slender corolla tube, which expands more abruptly into the limb, forming a narrowly campanulate to funnelform corolla. *Gentianella persquarrosa*, of Cusco Department, ca. 975 km to the south of the range of *G. rugicalyx*, is clearly monocarpic. It also differs from *G. rugicalyx* in its less leafy stems and usually in the presence of at least a few trichomes on the adaxial corolla surface. The pedicels of *G. persquarrosa* are more slender than those of *G. rugicalyx* and, although pedicel length in the two species overlaps, the average and maximum lengths are greater in *G. persquarrosa*, giving the inflorescence a more open aspect. Among other

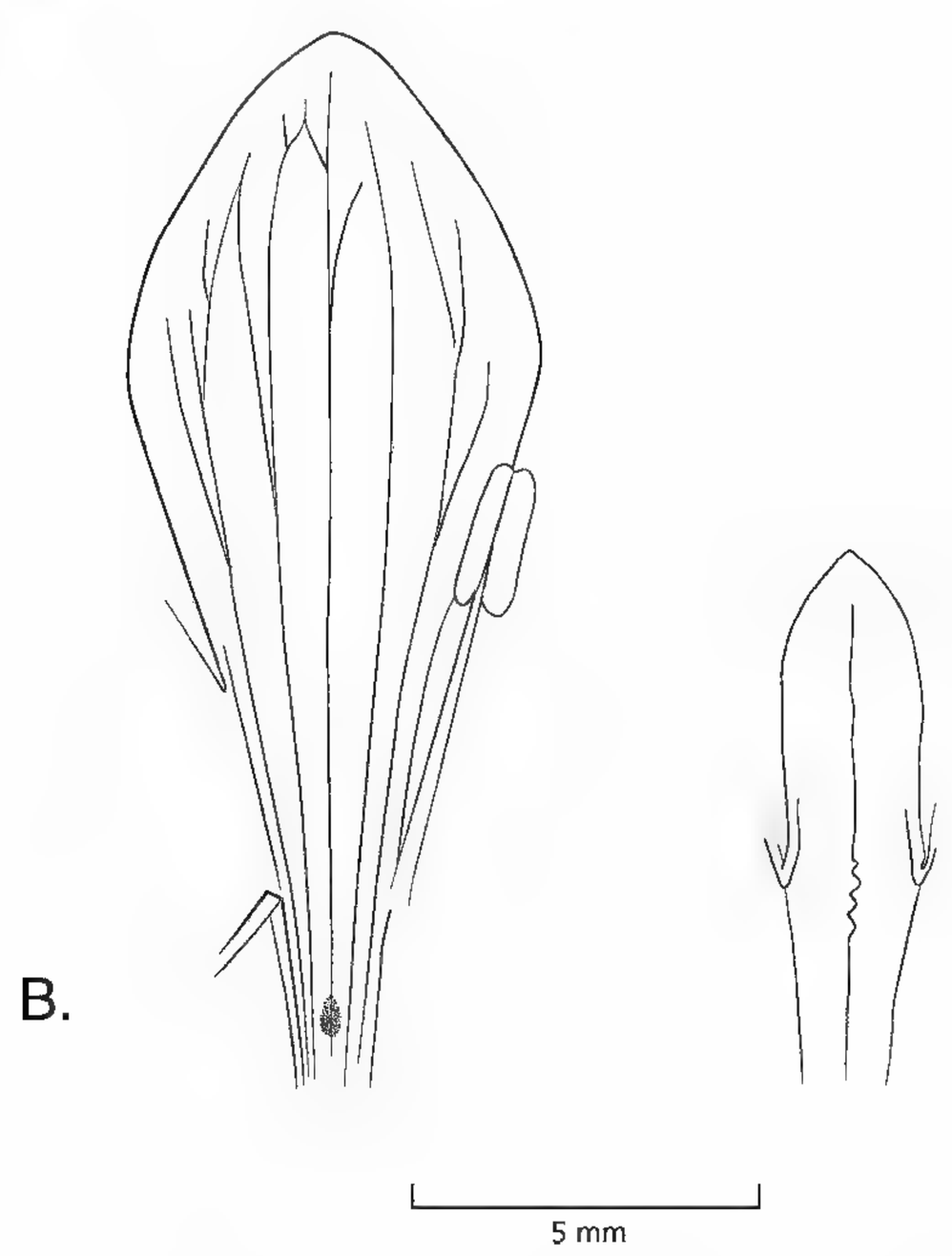


Figure 4. *Gentianella rugicalyx* J. S. Pringle. —A. Holotype, *Sagástegui A. et al. 11973*, plants. —B. Details of flower, drawn from the same specimen: left, corolla lobe and stamens, adaxial view; right, calyx lobe, abaxial view.

species similar in habit, *G. dolichopoda* (Gilg) J. S. Pringle, of Cusco Department, has glossier leaves, of which the largest are ca. 30 mm with slender pseudopetioles to half as long as the expanded portion, fewer basal and proximal cauline leaves, and yellow-throated corollas 16–23 mm. *Gentianella centamalensis* (Gilg) Zarucchi, of Amazonas Department, Peru, and *G. potamophila* (Gilg) Zarucchi, of

Apurímac, Arequipa, Ayacucho, and Cusco departments, differ in having corollas 16–25 mm with adaxial trichomes near the insertion of the stamens. *Gentianella centamalensis* differs further in its lilac, less deeply lobed corollas, and in *G. potamophila* a narrow, sharply demarcated dark purple zone, rather than a suffusion, extends along the outer edge of each corolla lobe. *Gentianella petrophila* (Gilg) Zarucchi, of Junín Department, Peru, differs in its narrower, acuminate calyx lobes and corolla lobes ca. 4× as long as the tube and proportionately narrower than those of *G. rugicalyx*. In *G. cerrateae* Fabris, of Ancash Department, the corolla lobes are shorter than the tube. In *G. sandiensis* (Gilg) J. S. Pringle, of southern Peru and Bolivia, the flowers are generally solitary, with no branching of the primary stems unless near the base, and the calyx lobes are shorter than to about as long as the tube.

Paratypes. PERU. **La Libertad:** Prov. Santiago de Chuco, Pampa de la Julia (al este de Quiruvilca), 23 May 2001, *S. Leiva G. & P. Leiva 2574* (F not seen, HAM, HAO not seen); Prov. Santiago de Chuco, Jalca de Quesquenda, 7°55.3′S, 78°10.2′O, 23 May 2001, *A. Sagástegui A. & M. E. Zapata C. 16576* (F not seen, HAM, HAO not seen).

5. Gentianella sanchezii J. S. Pringle, sp. nov. TYPE: Peru. Cajamarca: Prov. Cajamarca, SAIS, José Carlos Mariátegui, Km 15 on Sunchubamba–San Juan Rd., meadow, 5 June 1984, *D. N. Smith & I. Sánchez V. 7517* (holotype, MO; isotype, HAM). Figure 5.

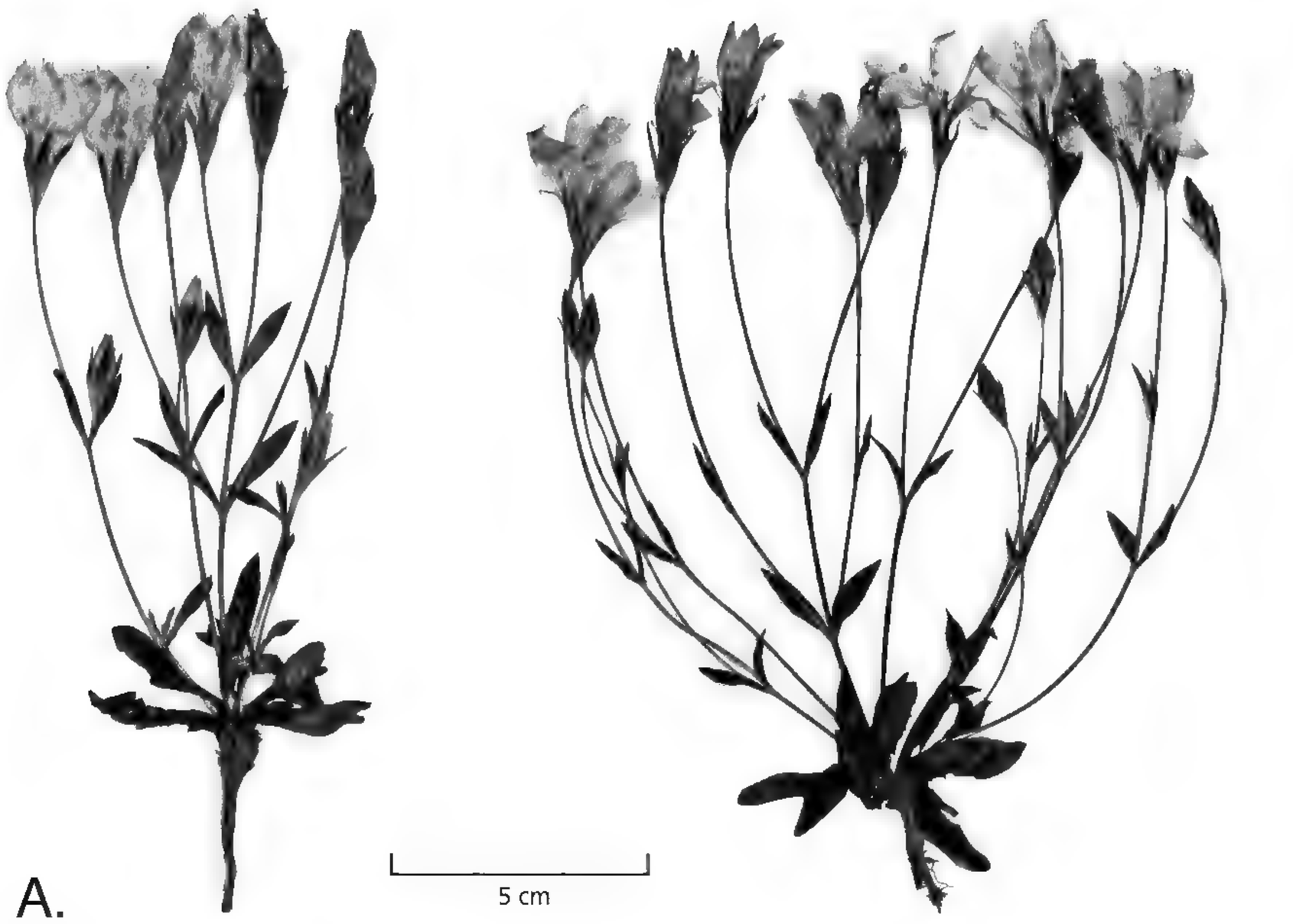
Inter *Gentianellas* andinas caulibus gracilibus e rosula persistente ortis, pedicellis quam internodiis plerumque longioribus et corollis late infundibuliformibus roseolilacinis 16 30 mm longis lobis spatulato-obovatis quam tubo duplo longioribus distinguenda.

Synoecious; plants monocarpic; taproot persistent; height 6–20 cm including pedicels and flowers; stems clustered, 2 to 14, glabrous, slender, ca. 1 mm diam. near base, to 13 cm (measured to most distal node in inflorescence); central stems ± erect, those toward periphery ± decumbent. Leaves medium to dark green, only midrib conspicuous, margins minutely roughened, bases of basal and proximal cauline leaves connected by low ridge or connate-sheathing to ca. 2 mm, distal leaf bases free; basal rosette leaves 6 to 16, present at flowering time, spatulate to oblanceolate or oblong, mostly 13–40 × 3–11 mm, narrowed at base or some leaves pseudopetiolate, obtuse to subacute at apex; cauline leaves sharply differentiated, 10–28 × 1–6 mm, narrowly elliptic or distal pairs linear, apex acute. Primary stems each forming a 3- to 6-flowered, monochasial or partly dichasial cyme, without or occasionally with 1 pair of leaves below first division, or stems of smallest plants bearing only 1 or 2 flowers; 1 to 5 internodes proximal to ultimate peduncles; proximal internodes mostly 1–5 cm, distal internodes (if any) usually longer; total flowers per plant 2 to ca. 50; pedicels mostly 20–75 mm, longer than internodes; smaller flowers occasionally present on shorter pedicels. Flowers erect; calyx obconic, 11–16 mm, tube and lobes ridged along midveins and commissural veins, giving tube a ribbed appearance; calyx lobes 5–9 mm, (1–)1.5–2× as long as tube, outer lobes lanceolate-triangular to oblong, 1.9–2.5 mm wide at base, inner lobes lanceolate-triangular to linear-oblong, 1–1.8 mm wide at base, margins smooth, apices acute to acuminate; adaxial colleters at base of calyx few; corolla pale purple to pink, widely funnelform, 16–30 mm; lobes spatulate-obovate, 11–17 × 6–9 mm, 1.8–2× as long as tube (or less in smallest flowers), 1.9–2.3× as long as wide, apices obtuse to abruptly acute, sometimes apiculate; trichomes absent; nectaries 5, ca. 0.8 × 0.6 mm; filaments inserted at ca. 0.8× height of corolla tube, 6.5–10 mm; anthers probably pale yellow when fresh, ca. 0.8 mm; ovary with indistinct stipe ca. 0.6 mm at anthesis; stigmas ± semicircular, 0.8–1 × 1–1.2 mm. Capsule not seen.

Habitat and distribution. The type of the name *Gentianella sanchezii* was collected at 3160 m and the paratype at 3824 m. Otherwise, information on the habitat of this species is limited to that on the herbarium labels, quoted here.

Discussion. In its open inflorescences with proportionately long pedicels, the size of its calyx and corolla, and the shape of its calyx and corolla lobes, *Gentianella sanchezii* is similar to *G. cuspidata* (Griseb.) J. S. Pringle, of Junín and Lima departments, Peru, ca. 500 km to the southeast, and to *G. campanuliformis* (Reimers) Fabris, of Cusco Department, ca. 1000 km to the southeast. Both *G. cuspidata* and *G. campanuliformis* differ in being tufted perennials with a distinct caudex, whereas *G. sanchezii* is evidently monocarpic, with a slender taproot and no caudex development. *Gentianella sanchezii* further differs from *G. cuspidata* in its much lower stature, more slender stems, fewer flowers per primary stem, less strongly sheathing leaf bases, and basal leaves that are less distinctly and shorter- or non-pseudopetiolate, and from *G. campanuliformis* in its fewer basal leaves and proportionately narrower basal and cauline leaves.

In some aspects of habit and corolla morphology, *Gentianella sanchezii* resembles *G. calanchoides* (Gilg) Fabris, of Huancavelica, Huánuco, and Junín departments, and *G. centamalensis* (Gilg) Zarucchi, of



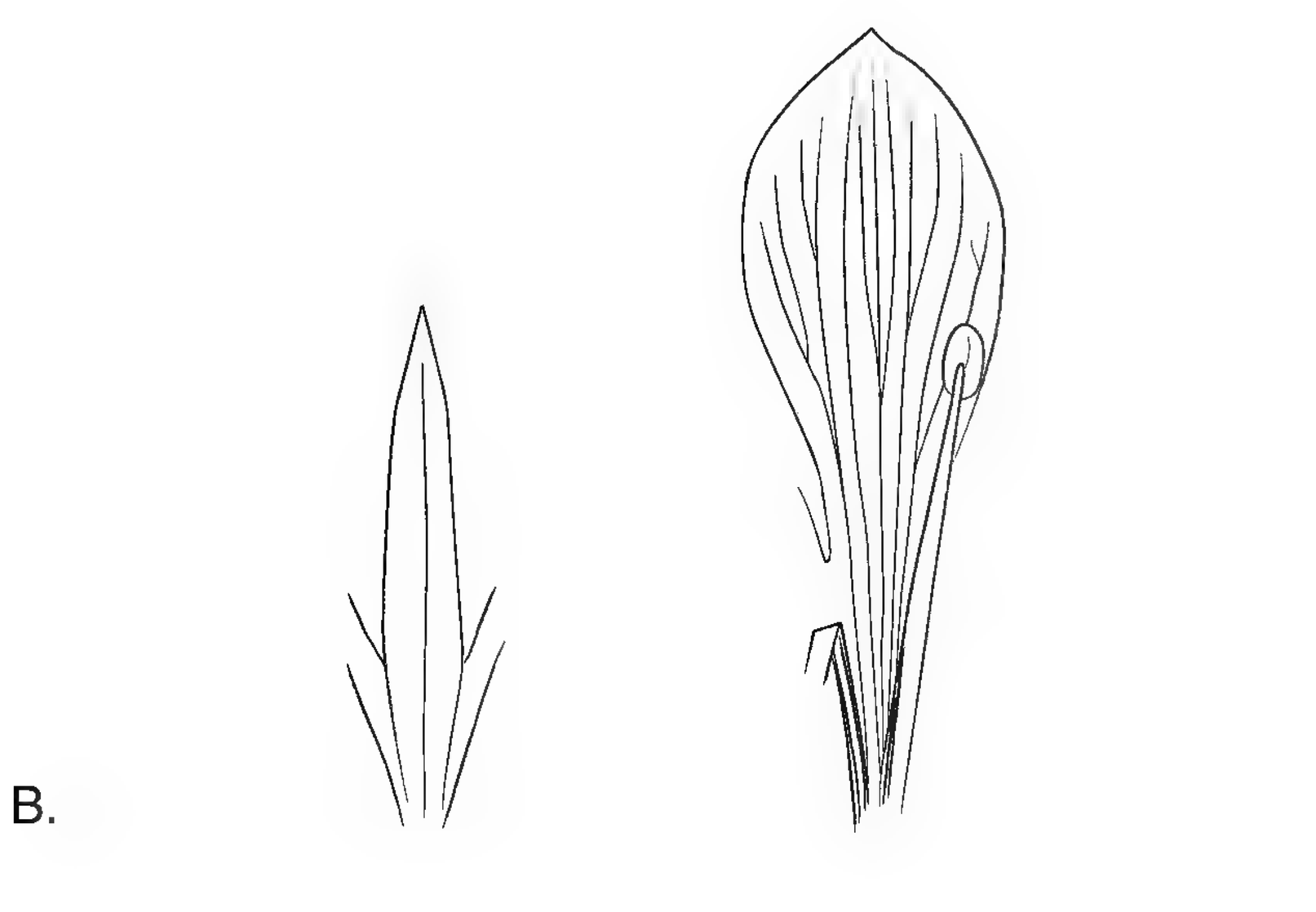


Figure 5. *Gentianella sanchezii* J. S. Pringle. —A. Holotype, *Smith & Sánchez V. 7517*, plants. —B. Details of flower, drawn from *Sagástegui A. & Zapata C. 16456* and *Smith & Sánchez V. 7517*: left, calyx lobe, abaxial view; right, corolla lobe and stamen, adaxial view.

Amazonas Department, but those species are perennials with stout caudices and have less deeply lobed corollas with numerous trichomes on the adaxial surface. From *G. roseolilacina* (Gilg) J. S. Pringle, of Ancash Department, *G. sanchezii* differs in its larger leaves, longer internodes and pedicels, larger flowers, and more deeply lobed corollas. Other *Gentianella* species in northern Peru to which *G. sanchezii* is more or less similar in stature and in the number of flowers per stem differ in having distinctly smaller flowers

and/or in the proportionate depth of the lobing of the corollas.

Paratype. PERU. **La Libertad:** Prov. Sánchez Carrión, Comumbamba (subiendo al nevado Huaylillas), 7°51.9′S, 78°01′O, ladera, 20 May 2001, *A. Sagástegui A. & M. Zapata C. 16456* (F not seen, HAM, HAO not seen).

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Himalayopteris, a New Fern Genus from India and the Adjacent Himalayas (Polypodiaceae, Polypodioideae)

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ABSTRACT. A new fern genus, *Himalayopteris* W. Shao & S. G. Lu (Polypodiaceae, Polypodioideae), is described and established based on the new combination *H. erythrocarpa* (Mett. ex Kuhn) W. Shao & S. G. Lu, for its only known species distributed in northern India, Sikkim, and the adjacent Himalayas. Evidence for its generic separation lies in its venation pattern, scale characteristics, leaf epidermis, sporangia, spore ornamentation, and chromosome number. Assessment of its IUCN conservation status with georeferenced localities places the new genus in the Vulnerable category.

Key words: Bhutan, China, *Himalayopteris*, India, IUCN Red List, Nepal, Polypodiaceae.

Polypodium erythrocarpum Mett. ex Kuhn (Polypodiceae) was originally published in 1869 and was later treated as *Goniophlebium erythrocarpum* (Mett. ex Kuhn) Bedd. by Beddome in 1876. When analyzing the type specimen from Kew, we found that the venation of this species corresponds to the description of Beddome (1876, 1883) in having a goniophlebioid pattern and dichotomous or trichotomous included veinlets, as illustrated in Figure 1B. Goniophlebioid venation occurs only in subfamily Polypodioideae, while drynarioid venation presents in other subfamilies of Polypodiaceae. However, Ching transferred *G. erythrocarpum* from *Goniophlebium* C. Presl to the genus *Phymatodes* C. Presl (Ching, 1933), and then to *Phymatopsis* J. Sm. (Ching, 1964), in what is now the subfamily Selligueae in the Polypodiaceae, because of its nonclathrate rhizome scales and the nonarticulation of the rachis, which differs from that seen in *Goniophlebium*. From examination of additional specimens in PE and HITBC, we confirm that the characteristics of the scales and rachis are as described by Ching in 1933, as shown in Figure 1D. Nonclathrate rhizome scales and nonarticulation of the rachis are distinguishing characteristics of this species.

Due to problems concerning the application of *Phymatodes* and *Phymatopsis*, Pichi Sermolli (1973) transferred *Phymatopsis erythrocarpa* to *Phymatopteris erythrocarpa* (Mett. ex Kuhn) Pic. Serm., but Japanese botanists treated *Phymatopteris* Pic. Serm. as a synonym of *Crypsinus* C. Presl (Nakaike, 1987). Rödl-Linder (1990) accepted this synonymy, with other species of *Phymatopteris* and *Crypsinus* assigned to *Selliguea* Bory in her monograph on *Goniophlebium*. Lu (2000) supported the prior treatment of Pichi Sermolli (1973), while Hovenkamp (1998) further treated *Phymatopteris* and *Crypsinus* as synonyms of *Selliguea*. Fraser-Jenkins (2008) separated this and certain other species from *Selliguea* as the genus *Pichisermollia* Fraser-Jenk. (non *Pichisermollia* H. C. Monteiro), now *Pichisermollodes* Fraser-Jenk. (Fraser-Jenkins, 2009). However, until now no one has separately recognized the individual species *P. erythrocarpa* generically.

During examination of the spores, leaf epidermis, and sporangia of this species under light microscope (LM) and scanning electron microscope (SEM), we found that the spores have slightly verrucate ornamentation (Fig. 1E) and that many trichomes are present on both sides of the leaf epidermis (Fig. 1C). We also found that this species has a setose sporangium, which rarely occurs in species of the Polypodiaceae.

The chromosome number of *Phymatopteris erythrocarpa* was reported from India by Malhotra in Mehra (1961: 162) as $x = 37$ (cited by Löve et al., 1977: 57, as $2n = 74$). This basic number is prevalent in subfamily Polypodioideae, but rare in *Phymatopteris*. No suitable material was available to cytologically investigate for this study, and the chromosome count needs further confirmation.

The lack of articulation in the rachis excludes this species from *Goniophlebium* (including *Schellolepis* J. Sm.), and the nonclathrate scales distinguish it from *Polypodiodes* Ching (including *Polypodiastrum* Ching). The goniophlebioid venation pattern and the basic chromosome number exclude this species from *Phymatopteris* and prevent the inclusion of this species in *Selliguea*. Because *Phymatopteris erythrocarpa* does not fit comfortably in any existing genus of the Polypodiaceae, we think it best to recognize this distinctive taxon at the genus level.

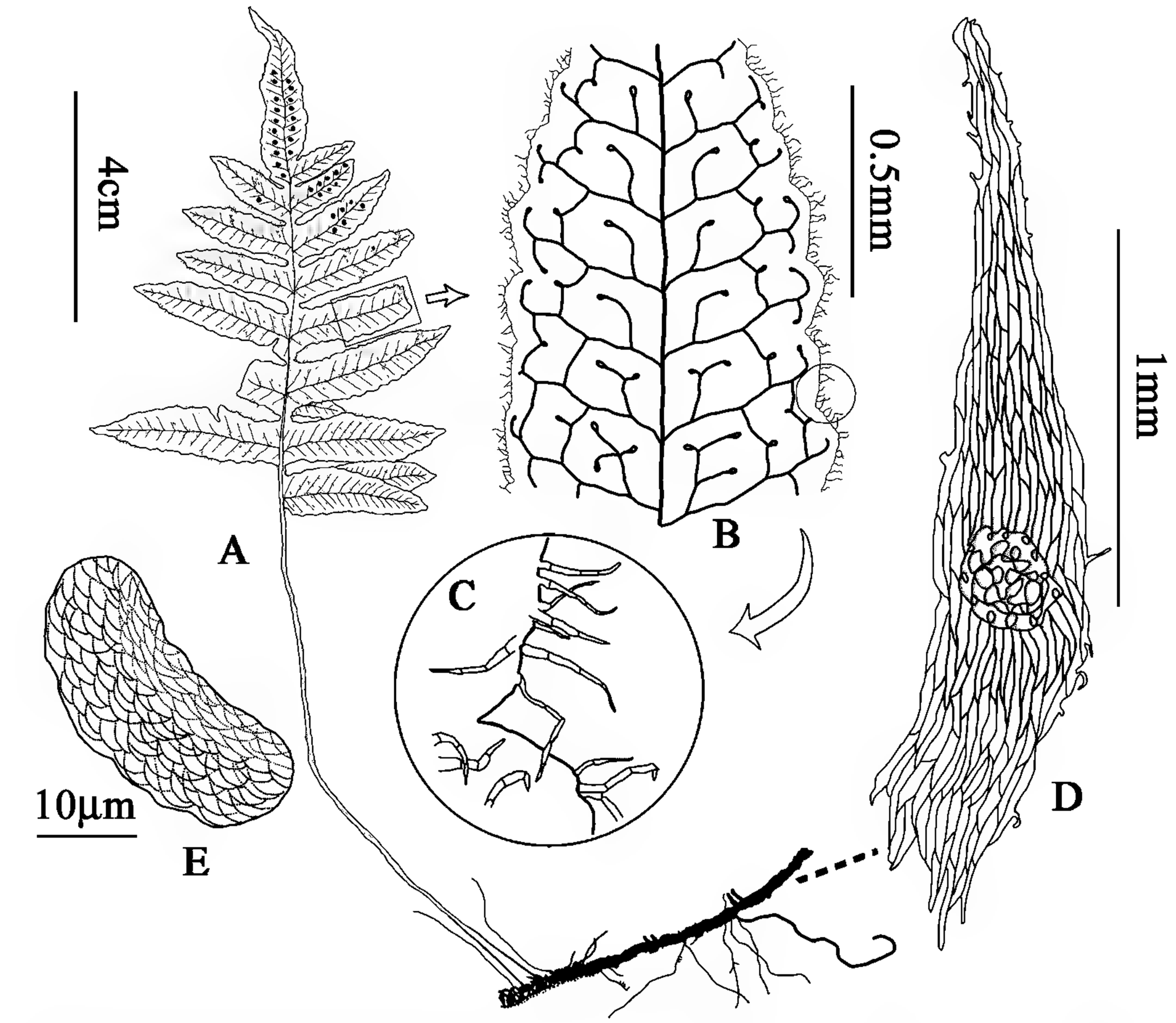

Figure 1. *Himalayopteris erythrocarpa* (Mett. ex Kuhn) W. Shao & S. G. Lu. —A. Frond. —B. Venation pattern. —C. Trichomes on lamina. —D. Scale. —E. Spore. Drawn from *Qinghai-Xizang Exped. 3998* (PE).

Himalayopteris W. Shao & S. G. Lu, gen. nov. TYPE: *Polypodium erythrocarpum* Mett. ex Kuhn [= *Himalayopteris erythrocarpa* (Mett. ex Kuhn) W. Shao & S. G. Lu]. Figure 1.

Genus novum quoad paleas non clathratas, rhachim ad laminae basim non articulatam etiam soros rotundos *Phymatopteridi* Pic. Serm. affine, sed ab ea numero chromosomatum $x = 37$, venatione goniophlebioidea atque areolis praesentibus distinguitur.

Rhizome long-creeping, 3–5 mm diam., bearing fronds 1–3 cm apart; the rhizome scales linear-lanceolate, castaneous in their central portion, brown and somewhat ciliolate marginally, acuminate at apex. Fronds simple, stipe 5–15 cm, stramineous, very slender; lamina pinnatifid, rachis with narrow wings or wingless in lower parts; lobes usually 1–5 × 0.8–1.5 cm, apex acute, with conspicuous main veins and distinct lateral veins, costal areoles in 1 or 2 series, the lowest lateral lobe somewhat decurrent; venation type goniophlebioid; margins with distinct small incisions or notches; texture subcoriaceous, with thick multicellular trichomes on both the abaxial and adaxial surfaces; apical part of lamina fertile, sori in a single series in the lower areoles.

Table 1 gives a comparison of the characteristics of the related genera of *Goniophlebium*, *Phymatopteris*, *Polypodiastrum*, *Polypodiodes*, and *Selliguea* with the new genus *Himalayopteris*.

Himalayopteris erythrocarpa (Mett. ex Kuhn) W. Shao & S. G. Lu, comb. nov. Basionym: *Polypodium erythrocarpum* Mett. ex Kuhn, Linnaea 36: 135. 1869. *Goniophlebium erythrocarpum* (Mett. ex Kuhn) Bedd., Suppl. Ferns Brit. Ind. 21, pl. 382. 1876. *Phymatodes erythrocarpa* (Mett. ex Kuhn) Ching, Contr. Inst. Bot. Natl. Acad. Peiping 2(3): 80. 1933. *Phymatopsis erythrocarpa* (Mett. ex Kuhn) Ching, Acta Phytotax. Sin. 9(2): 191. 1964. *Phymatopteris erythrocarpa* (Mett. ex Kuhn) Pic.

Table 1. Comparison of related genera with the new fern genus *Himalayopteris*.

	Himalayopteris	*Goniophlebium*	*Phymatopteris*	*Polypodiastrum*	*Polypodiodes*	*Selliguea* (syn. *Crypsinus*)
Chromosome number	$x = 37$	$x = 36, 37$	$x = 36$	$x = 37$	$x = 36, 37$	$x = 36, 37$
Scales	nonclathrate	clathrate	nonclathrate	clathrate	clathrate	nonclathrate
Leaf venation pattern	goniophlebioid type	goniophlebioid type	drynarioid type	goniophlebioid type	goniophlebioid type	drynarioid type
Areole of frond lobe	one lined areole	one or two lined areoles	no areole	one or two lined areoles	one lined areole	no areole
Rachis articulation	absent	present	absent	absent	absent	absent
Sori	round, superficial	round, superficial or slightly immersed	round, superficial or slightly immersed	round, slightly immersed	round, superficial	linear or round, superficial

Serm., Webbia 28(2): 462. 1973. *Pichisermollia erythrocarpa* (Mett. ex Kuhn) Fraser-Jenk., Taxon. Revis. Indian Subcontinental Pteridophytes 51. 2008. TYPE: India. N India, Sikkim, Lachen, 3500 m, 10 Dec. 1862, *J. D. Hooker s.n.* (holotype, K). Figure 1.

Distribution and habitat. The genus *Himalayopteris* is found in the western and eastern Himalayas in China (Tibet, Sichuan), India (northern India, Sikkim, Uttarakhand, Himachal Pradesh), Nepal, and Bhutan. The distributional ranges of *Goniophlebium*, *Phymatopteris*, and *Selliguea* extend into tropical southern Asia, the Malay Peninsula, and Indonesia, while *Polypodiastrum* can extend into Australia. *Polypodiodes* is sympatric with the new genus *Himalayopteris*, with the former occurring in Japan, Thailand, as well as southern and eastern China, while the latter is endemic to the western and eastern Himalayas. *Himalayopteris erythrocarpa* is epiphytic on tree trunks and has also been found growing superficially on mossy banks and among bushes.

IUCN Red List category. *Himalayopteris erythrocarpa* is known from seven allopatric populations endemic to the western and eastern Himalayas. Because the distributional areas for its known collection habitat have declined gradually, this species should be considered Vulnerable (VU) according to IUCN Red List criteria (IUCN, 2001).

Etymology. The new genus name is taken from the distribution of its sole known species, *Himalayopteris erythrocarpa*, for which all localities exist along the Himalayas.

Paratypes. BHUTAN. W Bhutan (Thimphu valley), 2500 m, *C. R. Fraser-Jenkins s.n.* (BM). CHINA. (Tibet, Motuo), 2700 m, 3 Aug. 1974, *Qinghai-Xizang Exped. 3998* (PE). **Sichuan:** Daocheng, 3400 m, *Qinghai-Xizang Exped. 6012* (HITBC). INDIA. N India (Himachal Pradesh, Simla), 2200 m, *Fraser-Jenkins s.n.* (BM); N India (Uttarakhand), 2700 2900 m, *Fraser-Jenkins s.n.* (BM); N India (Sikkim, Yakla valley), 2400 3300 m, *J. D. Hooker & T. Thomson s.n.* (K). NEPAL. E Nepal (Kathmandu), 3300 m, *Fraser-Jenkins s.n.* (BM).

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tions and P. Hovenkamp (L) for his comments on the treatment of *Phymatopteris* in the *Flora of China*. The first author expresses gratitude to Rosemary Davies (K) for adding this author's name to the IPNI author database, and to B. S. Kholia, Botanical Survey of India, Gangtok, Sikkim, for providing a photo of the live plant. This paper is supported by the National Natural Science Foundation of China (grant no. 30770164).

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Rubiacearum Americanarum Magna Hama Pars XXVI: New Species of *Hoffmannia* (Hamelieae) and More Comments on the Genus

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Abstract. Species of *Hoffmannia* Sw. (Rubiaceae, Hamelieae) are concentrated in premontane and montane areas of Central America and southern Mexico and are notably variable morphologically, but are here treated as less variable than some previous authors have concluded. In particular, corolla shape and color and fruit shape are here considered species-level characteristics, and leaf shape and inflorescence size and position are considered less variable than previously posited. Fourteen species new to science have been discovered by recent exploration in Central and South America and are described here. One group of species includes *Hoffmannia* plants from Nicaragua, Costa Rica, Panama, and northwestern Colombia with paired ant vesicles (i.e., formicaria) at the base of each leaf blade. These plants have recently been all included in one species, *H. vesiculifera* Standl., but two other previously described species are recognized here, *H. morii* Dwyer and *H. kirkbridei* Dwyer, along with five newly described species and all the *Hoffmannia* species with ant vesicles are keyed here. The newly described *Hoffmannia* species with ant vesicles on their leaves are: *H. formicaria* C. M. Taylor of Costa Rica and western Panama, which differs from *H. morii* by its pedunculate inflorescences, pedicellate flowers, and white, greenish yellow, or pink corollas; *H. limonensis* C. M. Taylor of Costa Rica and western Panama, which differs from *H. vesiculifera* by its corollas with the acute to acuminate lobes longer than the tube; *H. pseudovesiculifera* C. M. Taylor of western Panama, which differs from *H. vesiculifera* by its scorpioid inflorescences and corollas with the lobes longer than the tube and in general unusually long within the genus; *H. subcapitata* C. M. Taylor of Costa Rica, which differs from *H. kirkbridei* by its shorter petioles, subcapitate pedunculate inflorescences, and longer broader calyx lobes; and *H. veraguensis* C. M. Taylor of western Panama, which differs from *H. formicaria* by its shorter calyx lobes and smaller corollas. The remaining *Hoffmannia* species newly described here lack ant vesicles on the leaves: *H. barbillana* C. M. Taylor of Costa Rica differs from *H. longipetiolata* Pol. in its sessile leaves that are rounded at the base and its epiphytic habit; *H. boliviana* C. M. Taylor of Bolivia and Peru differs from *H. obovata* (Ruiz & Pav.) Standl., *H. latifolia* (Bartl. ex DC.) Kuntze, and *H. pearcei* Rusby in its longer petioles, broader leaves, and smaller flowers; *H. coriacea* C. M. Taylor of central Peru is distinguished within *Hoffmannia* by its narrow leathery leaves and corolla with the tube longer than the lobes; *H. costaricensis* C. M. Taylor of Costa Rica differs from *H. valerioi* Standl. in its shorter calyx lobes and oblanceolate leaves; *H. micrantha* C. M. Taylor of Costa Rica differs from *H. hammelii* C. M. Taylor by its orange, brown, or purple corollas that are acute in bud; *H. pacifica* C. M. Taylor of Costa Rica is distinguished from *H. hammelii* by its subsessile leaves that are rounded to cordulate at the base; *H. rivalis* C. M. Taylor of lowland Peru is distinguished by its rheophytic habit, densely pubescent stems, narrow leaves, and small flowers; *H. tilaranensis* C. M. Taylor of Costa Rica differs from *H. nicotianifolia* (M. Martens & Galeotti) L. O. Williams in its larger red to purple flowers and larger leaves; and *H. turrialbana* C. M. Taylor of Costa Rica is distinguished from *H. pittieri* Standl. by its subsessile leaves that are truncate to cordulate at the base and have numerous secondary veins plus its few-flowered racemiform inflorescences.

Resumen. Las especies de *Hoffmannia* Sw. (Rubiaceae, Hamelieae) se concentran en áreas premontanas y montanas de América Central y el sur de México y muestran una variación morfológica notable, pero aquí se tratan con menos variación que algunos autores anteriores han concluido. En particular aquí la forma y el color de la corola y la forma del fruto se consideran características al nivel de especie, y la forma de las hojas y el tamaño y la posición de la inflorescencia se consideran menos variables que antes se ha propuesto. Catorce especies nuevas a la ciencia se descubrieron a través de exploraciones recientes en América Central y América del Sur, y se describen aquí. Un grupo de especies incluye las plantas de *Hoffmannia* de Nicaragua, Costa Rica, Panamá y el noroeste de

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Colombia con vesículas hormigueras (i.e., formicarios) en pares en la base de la lámina de cada hoja. Estas plantas recientemente se incluyeron todas en una sóla especie, *H. vesiculifera* Standl., pero dos más especies anteriormente descritas se reconocen aquí, *H. morii* Dwyer y *H. kirkbridei* Dwyer, con cinco especies nuevamente descritas y todas las especies de *Hoffmannia* con vesículas hormigueras se distinguen aquí en una clave. Las especies de *Hoffmannia* con vesículas hormigueras en las hojas que se describen nuevamente aquí son: *H. formicaria* C. M. Taylor de Costa Rica y el oeste de Panama, la cual se distingue de *H. morii* por las inflorescencias pedunculadas, las flores pediceladas y las corolas de color blanco, amarillo verdoso o rosado; *H. limonensis* C. M. Taylor de Costa Rica y el oeste de Panama, la cual se distingue de *H. vesiculifera* por las corolas con sus lobos agudos a acuminados y más largos que el tubo; *H. pseudovesiculifera* C. M. Taylor del oeste de Panama, la cual se distingue de *H. vesiculifera* por las inflorescencias escorpioides y las corolas con sus lobos más largos que el tubo, y estes lobos por lo general excepcionalmente largos dentro del género; *H. subcapitata* C. M. Taylor de Costa Rica, la cual se distingue de *H. kirkbridei* por los pecíolos más cortos, las inflorescencias subcapitadas y pedunculadas y los lobos del cáliz más largos y más anchos; y *H. veraguensis* C. M. Taylor del oeste de Panama, la cual se distingue de *H. formicaria* por los lobos del cáliz más cortos y la corola de tamaño menor. Las otras especies de *Hoffmannia* que se describen aquí no tienen vesículas hormigueras en las hojas: *H. barbillana* C. M. Taylor de Costa Rica se distingue de *H. longipetiolata* Pol. por las hojas sésiles con la base redondeada y el hábito epifítico; *H. boliviana* C. M. Taylor de Bolivia y Peru se distingue de *H. obovata* (Ruiz & Pav.) Standl., *H. latifolia* (Bartl. ex DC.) Kuntze y *H. pearcei* Rusby por los pecíolos más largos, las hojas más anchas y las flores de tamaño menor; *H. coriacea* C. M. Taylor del centro de Perú se distingue dentro de *Hoffmannia* por las angostas hojas coriáceas y la corola con el tubo más largo que los lobos; *H. costaricensis* C. M. Taylor de Costa Rica se distingue de *H. valerioi* Standl. por los lobos del cáliz más cortos y las hojas oblanceoladas; *H. micrantha* C. M. Taylor de Costa Rica se distingue de *H. hammelii* C. M. Taylor por las corolas de color anaranjado, pardo o purpúreo y agudas en el botón; *H. pacifica* C. M. Taylor de Costa Rica se distingue de *H. hammelii* por las hojas subsésiles y redondeadas a corduladas en la base; *H. rivalis* C. M. Taylor de tierra baja en Perú se distingue por su hábito de reófilo, los tallos densamente pubescentes, las angostas hojas y las flores pequeñas; *H. tilaranensis* C. M. Taylor de Costa Rica se distingue de *H. nicotianifolia* (M. Martens & Galeotti) L. O. Williams por las flores de tamaño mayor y de color rojo a purpúreo y las hojas más grandes; y *H. turrialbana* C. M. Taylor de Costa Rica se distingue de *H. pittieri* Standl. por las hojas subsésiles, truncadas a corduladas en la base y con numerosas venas secundarias además las inflorescencias racemiformes paucifloras.

Key words: Ant plants, Bolivia, Colombia, Costa Rica, Ecuador, Hamelieae, *Hoffmannia*, IUCN Red List, Panama, Peru, Rubiaceae.

The Neotropical genus *Hoffmannia* Sw. (Rubiaceae, Hamelieae) comprises perhaps 100 species of herbs, subshrubs, and low woody plants found in the understory of wet vegetation from sea level to montane forests. These plants are characterized by opposite or verticillate leaves, deciduous stipules that are interpetiolar or very shortly fused around the stem, axillary cymose inflorescences of varied form, 4-merous homostylous flowers, rather small corollas with the lobes imbricate in bud, generally 2-locular ovaries, and small fleshy baccate fruits containing numerous angled seeds. The stipules are often distinctive in form, with part or all of their structure fleshy to quite succulent, frequently protruding or spreading from the stem, and sometimes glandular and/or ornamented with additional projections. *Hoffmannia* is found from Mexico through Central America and the Andes to western Argentina, and in Jamaica, the Lesser Antilles, and Venezuela; however, reports of *Hoffmannia* from the Guianas were apparently all based on misidentifications of *Patima* Aubl. (Delprete et al., 2005; Taylor & Lorence, 2010). *Hoffmannia* has never been studied as a whole, though a number of regional treatments have been published (Standley, 1936, 1938; Standley & Williams, 1972; Steyermark, 1974; Dwyer, 1980; Burger & Taylor, 1993) as well as several overviews of the genus in particular regions (Standley, 1934; Dwyer, 1969; Williams, 1973; Burger, 1999). No infrageneric classification has been proposed for this genus; instead most study has focused on circumscribing it and distinguishing individual species (Lorence & Dwyer, 1988; Burger & Taylor, 1993; Delprete et al., 2005). During study of recently collected specimens of Neotropical Rubiaceae, several undescribed species of *Hoffmannia* were discovered and necessitate a review of the genus and its morphology.

Hoffmannia belongs to the tribe Hamelieae (Robbrecht & Manen, 2006; Bremer & Eriksson, 2009), which has its center of diversity in southern

Mexico and northern Central America. All five of the genera of Hamelieae are found here: *Omiltemia* Standl. and *Pinarophyllon* Brandegee are restricted to this region, and *Deppea* Cham. & Schltdl. (Lorence & Dwyer, 1988), *Hoffmannia* (Burger, 1999), and *Hamelia* Jacq. (Elias, 1976) have species-level radiations here. Only *Hamelia* and *Hoffmannia* reach South America, with a minority of their species there. Vegetatively these last two genera are often confused, but, when fertile, *Hamelia* can be recognized by its terminal inflorescences and 5-merous flowers. *Hoffmannia* is also frequently confused with *Notopleura* (Benth. & Hook. f.) Bremek. (Psychotrieae), which is often sympatric and similar in habit, and often has similar fleshy projecting stipules. However, *Notopleura* can be separated by its pseudoaxillary inflorescences (i.e., borne in only one axil of the node vs. consistently in both axils in *Hoffmannia*), 5-merous flowers, and drupaceous fruits with two to six plano-convex pyrenes, with each pyrene containing only one seed.

Morphology of *Hoffmannia*

Hoffmannia includes a notable range of morphological variation, as noted by previous authors (Burger, 1999). This variation has complicated its taxonomy. Here several morphological characters of *Hoffmannia* are reviewed across the genus as a basis for further study.

Plants of *Hoffmannia* are often quite succulent and consequently shrink and often change form when dried, so study of these species only as dried specimens has long been recognized as limiting (Dwyer, 1969). In particular, many *Hoffmannia* species have distinctive succulent stipules whose form is lost on dried specimens. The form of such succulent stipules is characteristic of individual species of *Notopleura* (Taylor, 2001), and it seems likely that the same is true for *Hoffmannia*, but field observations are needed.

Several *Hoffmannia* species have been distinguished in part based on their verticillate rather than opposite leaf arrangement, but in fact this arrangement may vary within a species: verticillate-leaved species have occasional opposite-leaved plants, and conversely plants of typically opposite-leaved species occasionally produce verticillate leaves at some nodes. Such variation has been noted in species descriptions, but not always in identification keys. Petiole and leaf blade size have also been used to distinguish species, but in fact these structures often vary markedly in size within many *Hoffmannia* species, sometimes even on consecutive stem nodes of a single plant. The full range of this variation has not been documented in many descriptions.

Inflorescence arrangement has been considered by several authors to be widely variable within *Hoffmannia* species (Dwyer, 1969; Burger, 1999) and has been described only generally for most species. However, the inflorescence arrangement changes significantly over time in many *Hoffmannia* species: the young inflorescences are compact and subcapitate or have only very short axes when the first flowers open, then these axes elongate as the fruits develop and subsequent flowers open, and the inflorescence becomes more lax and often develops a characteristic arrangement. This developmental sequence has often been overlooked, but when it is considered *Hoffmannia* species can be characterized by the form of their expanded inflorescence, whether cincinnate, dichasial to umbelliform, or scorpioid-racemiform.

The flower color of *Hoffmannia* species has also sometimes been regarded as unusually variable in Rubiaceae (Dwyer, 1969; Burger, 1999), in several cases ranging from pink to rose-red, dark red, yellow, orange, or white. However, when species are circumscribed with a narrower range of variation in stipule, inflorescence, and corolla form, then flower color is usually also less variable. The remaining *Hoffmannia* species with apparently broad ranges of flower color probably deserve additional study, including field observations. No flower odor has been reported in collection data studied.

The comparative length of the corolla tube versus the lobes seems to be characteristic of individual species of *Hoffmannia*, as noted by several authors (e.g., Standley, 1934). *Hoffmannia* flowers with the corolla lobes much longer than the tube and widely spreading at anthesis present an open, flat to concave flower and have been traditionally described as rotate. However, these corollas do have a short, cylindrical, tubular base, so this form is not entirely comparable to other flowers described as rotate. Lorence and Dwyer (1988) studied both dried and living plants and confirmed the imbricate corolla aestivation of *Hoffmannia*, as noted by Standley (1934, 1936, 1938), Dwyer (1969), and Burger (1999). Lorence and Dwyer found that corolla lobes are often only very narrowly overlapping and that their arrangement may be variously simple imbricate, alternative, or quincuncial, sometimes all on the same plant. The basis for Delprete's (1998) unique description of the corolla aestivation of *Hoffmannia* as left-contorted is not known and possibly problematic for his generic comparison there.

Dwyer (1969) noted variation in stamen number in *Hoffmannia* and reported flowers on some plants with

four corolla lobes, but variously three, four, or five stamens. Dwyer treated these plants with different stamen numbers as distinct species, but other authors have considered this variation similar to the idiosyncratic individual flowers with anomalous corolla lobe and stamen numbers found in most species of Rubiaceae and have not recognized these as separate species (e.g., Burger, 1999). Dwyer also noted prolongations and ornamentations of the anther connective, and suggested that this feature is characteristic and perhaps diagnostic of individual species; it is not evaluated in this present article but merits study.

Dwyer (1969) and Hayden (1968) also noted variation in locule number in *Hoffmannia*, with most flowers of most species 2-locular, but some species characteristically 3- or 4-locular. In fact, some *Hoffmannia* species of Mexico and Central America have consistently 4-locular ovaries (*H. oaxacensis* Lorence & Dwyer ex Borhidi, *H. tetrastigma* Donn. Sm.), and some others are variable with both 3- and 4-locular ovaries (*H. cuneatissima* B. L. Rob., *H. nesiota* Donn. Sm.).

Hoffmannia's fruits are generally fleshy, though they are spongy or mealy and often rather dry instead of juicy. The fruits are usually baccate and dispersed as an intact structure, but Lorence and Dwyer (1988) noted that sometimes these fruits are tardily dehiscent to release the seeds contained in the dry interior of the locules. The locule walls are sometimes stiffened so that the fruits on dried specimens may appear to contain two to four pyrenes (contributing to the confusion between *Hoffmannia* and *Notopleura*), but these locule walls rupture easily and irregularly to release the numerous tiny dry seeds. Dwyer (1969) noted that the fruits are often removed by frugivorous animals from the plants as soon as they are ripe, thus as with some species of *Psychotria* L. the fruit color may change quickly just before dispersal so that the color generally described for a particular species may not be the mature fruit color. However, some *Hoffmannia* species may indeed produce fruits of more than one color, as in some species of *Gonzalagunia* Ruiz & Pav.; field observations are needed to confirm this. The detailed seed morphology of a few *Hoffmannia* species was studied by Hayden (1968), but the seeds of most *Hoffmannia* species have not been described or measured.

Taxonomic Concepts and Biogeography

At least two thirds of the species of *Hoffmannia* are found in Mexico and Central America and on average appear to have rather limited geographic distributions there and a higher rate of endemism or highly localized distribution than found in most other Rubiaceae genera (Williams, 1973; Burger, 1999). The pattern of individual species distributions here suggests that species-level radiations have occurred within southern Mexico and northern Central America, and separately within Costa Rica and Panama. In contrast, the species of *Hoffmannia* found in South America are on average more widely distributed, except in the mountains of Venezuela, where there also appears to be a species-level radiation (Steyermark, 1974). Two species are found on Isla del Coco in the Pacific Ocean (Trusty et al., 2006), and both are endemic while most of the other Rubiaceae found there are conspecific with mainland plants.

Kiehn (1995) noted that polyploidy is found in the tribe Hamelieae, including within several species of *Hoffmannia* (Kiehn, 1986). He also documented within-species chromosome number variants that are not multiples, but represent some other type of aneuploid variation. This chromosomal variability may play a role in the morphological complexity of this genus.

The *Hoffmannia vesiculifera* Group

One group of *Hoffmannia* plants is particularly distinctive: the *H. vesiculifera* or vesiculate-leaved group comprises low to robust herbs and subshrubs with a pair of well-developed vesicles or formicaria at the base of each leaf blade, hirsute or hispid pubescence at least on the youngest growth, cymose to capitate inflorescences, and usually white to yellow corollas. (The specific epithet of *H. vesiculifera* Standl. was originally published with the variant spelling "vesciculifera," but that spelling has not been found in Latin usage and is cited as incorrect by the reference "Words by William Whittaker" <http://lysy2.archives.nd.edu/cgi-bin/words.exe>; as an orthographic error, Standley's spelling is correctable.) The vesiculate-leaved plants are known from southern Nicaragua through Panama and perhaps also occur in northwestern Colombia, but such reports are unconfirmed by this present study. One species from Panama, *H. dwyeri* W. C. Burger, is similar to the vesiculate-leaved species in its pubescence and general aspect, and has unusual pandurate leaf blades. These leaf blades are narrowed near the base, then shortly broadened and flared, then truncate at the base of the blade tissue with this basal flared portion revolute to somewhat cupuliform. *Hoffmannia dwyeri* may represent an intermediate condition between the vesiculate-leaved plants and those without ant vesicles, or it may have an unusual

form of ant vesicle; however, this basal leaf portion does not form a closed vesicle and there is no evidence on the specimens of ants inhabiting this structure, so *H. dwyeri* is provisionally excluded from the *H. vesiculifera* group.

Standley (1934), Dwyer (1980), and Burger (1999) circumscribed only one to three species among the vesiculate-leaved plants. They all recognized *Hoffmannia vesiculifera* (Dwyer, 1980: 243, fig. 52) with an unusually broad range of morphological variation, even for *Hoffmannia*, and Standley explicitly considered the presence of the ant vesicles to distinguish one widespread species rather than a group of species. Burger generally accepted this conclusion, but did recognize a second vesiculate-leaved species, *H. kirkbridei* Dwyer, and Dwyer recognized both of those species plus *H. morii* Dwyer. In contrast, this vesiculate-leaved group is here regarded as an example of a species-level radiation in southern Central America, and eight species are distinguished here based on details of the inflorescence arrangement, form and size of the calyx lobes, and form, size, and color of the corollas. This classification of the vesiculate-leaved plants benefits from numerous *Hoffmannia* collections made since those previous studies.

Key to Species of the *Hoffmannia vesiculifera* Group

1a. Leaves with petioles (i.e., below the vesicles) 4–11 cm long; leaf blade 10–18 cm wide; calyx lobes 1.5–3 mm long; fruit white ..... *H. kirkbridei*
1b. Leaves sessile or with petioles to 2 cm long; leaf blade 7–15.5 cm wide; calyx lobes 2.5–15 mm long; fruit pink to red (unknown in *H. subcapitata*).
2a. Inflorescences sessile or subsessile, subcapitate or densely congested-cymose; calyx lobes 4–5 mm long, weakly arched to usually recurved at apex, more densely pubescent in distal portion, often red to purple or green with red to purple trichomes; corolla yellow, orange, or red, with tube 4–5 mm long and lobes ca. 5 mm long ..... *H. morii*
2b. Inflorescences sessile or pedunculate, variously capitate, subcapitate, glomerulate, cymose, cincinnate, or scorpioid-racemiform; calyx lobes 2.5–17 mm long, generally erect or straight, and variously glabrous, uniformly pubescent along their length, or pubescent throughout but more densely so at apex; corolla white, yellow, pink, or pale green, with tube 2–14 mm long and lobes 4–15 mm long.
3a. Inflorescences corymbiform or dichasial; calyx lobes 10–17 mm long; corolla with tube 13–14 mm long and lobes 6–10 mm long, the tube clearly longer than the lobes ..... *H. vesiculifera*
3b. Inflorescences capitate, subcapitate, glomerulate, cincinnate, or scorpioid-racemiform; calyx lobes 2.5–7 mm long; corolla with tube shorter than or about equal to lobes.
4a. Calyx lobes 4–7 mm long, linear; corolla in bud sharply acute, at anthesis with lobes 10–14 mm long, acute to acuminate or apiculate; shrubs or subshrubs generally flowering at 1–3 m tall ... *H. limonensis*
4b. Calyx lobes 2.5–5 mm long, triangular to linear; corolla in bud acute to obtuse or rounded, at anthesis with lobes 5–7 mm long, obtuse to acute; herbs or subshrubs to 2 m tall, often flowering at 0.5–0.8 m tall.
5a. Inflorescences subcapitate or congested-cymose, subglobose in overall shape, with bracts developed, ligulate, 1.2–2 mm wide; calyx lobes ligulate, rather broad, 1.2–2 mm wide; corolla yellow, unlined ..... *H. subcapitata*
5b. Inflorescences cincinnate or scorpioid-racemiform, corymbiform to irregular in overall shape, with bracts reduced or linear, up to 0.5 mm wide; calyx lobes linear or narrowly triangular, 0.1–0.5 mm wide; corolla white, yellow, orange, greenish yellow, or pink, sometimes marked with lines inside.
6a. Calyx lobes 7–10 mm long; corolla yellow to orange, unlined, with tube 8–11 mm long and lobes 14–20 mm long ..... *H. pseudovesiculifera*
6b. Calyx lobes 1–4 mm long; corolla white, greenish yellow, or pink, often marked with lines inside, with tube 3–6 mm long and lobes 3.5–6 mm long.
7a. Calyx lobes 2.5–4 mm long, sparsely to densely villous or hirsute with pubescence often denser in apical portion; corolla with tube 4–5 mm long and lobes 5–7 mm long ..... *H. formicaria*
7b. Calyx lobes 1.2–4 mm long, glabrescent; corolla with tube 3–4 mm long and lobes 3.5–5 mm long ..... *H. veraguensis*

Methods

The new species described here are treated together (i.e., the species are not separated according to the presence of ant vesicles) and arranged in alphabetical order. These new species were discovered among specimens made by various projects focused on floristic study of tropical forest regions that are not well known to science, with most of the collections made within the last 15 years. Additional collection data for the specimens cited here are available at <http://www.tropicos.org>, along with high-resolution digital images of the type specimens or reference specimens of the species newly described here and the previously described species keyed here.

Conservation status assessment methodology. The study presented here is taxonomic and floristic: the objective is enumeration of the species that belong to various Rubiaceae genera and the species that occur in the area of tropical Central and South America. The methods employed here correspond only to this objective; thus this study is based on survey of specimens collected over a number of years using varied survey methods aimed at various objectives. The specimens here used to delineate the range and commonness of these new species were located through a nonexhaustive survey of several herbaria, and no field studies have been done targeting the occurrence of these species where they are known or expected to grow. Thus the floristic information presented here is a simplified presence report based on incomplete survey of the available data, which are uneven and incomplete for this region (Schulman et al., 2007). Knowledge of the true geographic range and the population size and dynamics of a species are essential to understanding the threats to its existence, and thus to understanding its actual conservation status; documentation of the existence of a species based on one or several museum collections does not provide adequate data to evaluate these factors. Conservation assessments are provided here for these newly described species using IUCN categories and criteria (IUCN, 2001) based on the totality of our current knowledge. The basis for these assessments in the form of a map and the calculated assessment parameters are available under the corresponding species names at <http://www.tropicos.org> (assessment parameters for each map can be seen using "Show Detail"). The assessment parameters were calculated using the IUCN Rating tool (Moat, 2007) in ArcView GIS 3.2 (ESRI, 1999), with the grid cell size used for calculating Area of Occupancy (AOO) varied between 1 and 3.16 km depending on characteristics of the species and data (IUCN Standards and Petitions Working Group, 2008). These assessments are not being submitted to IUCN for publication on the Red List (<http://www.iucnredlist.org>), and the basis for these assessments should be carefully evaluated by the reader.

Taxonomy

Hoffmannia Sw., Prodr. 30. 1788. TYPE: *Hoffmannia pedunculata* Sw.

Soft to suffrutescent herbs, shrubs, or infrequently small trees, glabrous or variously pubescent, sometimes unbranched, sometimes apparently stoloniferous, often fleshy or rather succulent, with raphides. *Leaves* opposite or sometimes in verticils of 3 to 4, sessile to petiolate, thin-textured or fleshy in life and drying thin-textured, infrequently markedly bullate, without axillary domatia, infrequently with paired swollen vesicles 1–2 cm long at base of blade, venation eucamptodromous or brochidodromous; *stipules* interpetiolar or shortly fused around the stem, caducous or sometimes with truncate basal portion persisting at least shortly after upper portion has fallen, subtruncate to triangular, sometimes succulent, occasionally with a pyramidal or ornamented medial projection, rarely 2-lobed, infrequently apparently glandular. *Inflorescences* axillary (i.e., produced in both axils of the node), variously borne with vegetative leaves and/or along bare stems below the leaves, sessile to pedunculate, capitate, glomerulate, fasciculate, or congested to laxly cymose, bracteate or with bracts reduced, the axes dichasial or sometimes becoming cincinnate or scorpioid-racemiform. *Flowers* sessile to pedicellate, bisexual, homostylous, apparently protandrous, apparently diurnal; *calyx* limb shortly to deeply 4-lobed; *corolla* funnelform, somewhat salverform or rotate (i.e., with a narrow cylindrical tube that is significantly shorter than the widely spreading lobes), variously white, yellow, pale green, yellowish green, pink, salmon, red, or purple, internally glabrous, lobes 4, in bud imbricate simply, alternatively, or quincuncially, with all arrangements sometimes found on the same plant (Lorence & Dwyer, 1988); *stamens* (3)4(5), exserted, anthers narrowly oblong or ellipsoid-oblong, often bright white, with connective sometimes prolonged at one or both ends; ovary 2(to 4)-celled, ovules numerous, peltate on axile placentas; *stigmas* 2(to 4), linear, clavate or lanceolate, exserted, often bright white or strikingly colored. *Fruit* baccate, generally subglobose to ellipsoid, fleshy and variously juicy, mealy, spongy, or rarely ultimately capsular with apparently irregular dehiscence (Lorence & Dwyer, 1988), white, pink, orange, red, or purple-black; *seeds* numerous, angled, reticulate to foveolate, with surface granular between fenestrated walls (Hayden, 1968), 0.2–0.3 mm.

1. **Hoffmannia barbillana** C. M. Taylor, sp. nov. TYPE: Costa Rica. Limón: cantón Matina, Parque Nac. Barbilla, entrada principal, cuenca del Matina, 10°00′N, 83°23′W [apparently 83°42′W], 21 Aug. 2000, *E. Mora 1417* (holotype, INB; isotypes, CR, MO-04799715). Figure 1C, D.

Haec species a *Hoffmannia longipetiolata* Pol. foliis sessilibus subsessilibusve basi rotundatis subtruncatisve atque habitu epiphytico distinguitur.

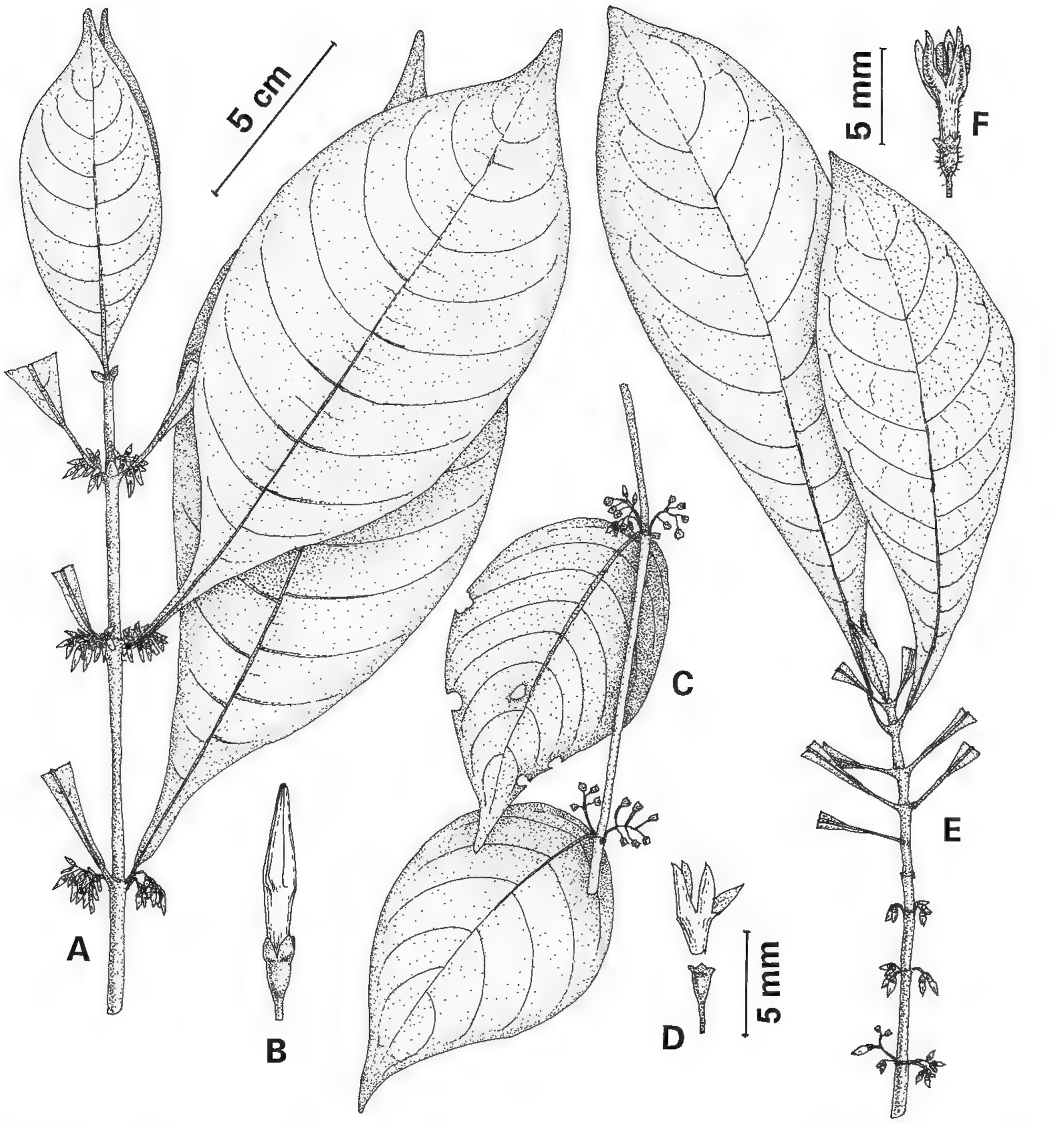

Figure 1. A, B. *Hoffmannia tilaranensis* C. M. Taylor. —A. Portion of flowering stem; based on the paratype *Taylor 3026* (DUKE). —B. Flower bud; based on the type *Haber & Bello 1685* (MO). C, D. *H. barbillana* C. M. Taylor; based on the type *Mora 1417* (MO). —C. Portion of flowering stem. —D. Flower, partially dissected. E, F. *H. costaricensis* C. M. Taylor; based on the type *Grayum & Schatz 5154* (MO). —E. Portion of flowering stem. —F. Flower bud (opened prematurely in drying press). A, C, E drawn to same scale, indicated as 5 cm; B, F drawn to same scale, indicated as 5 mm.

Herbs or soft shrubs to 2 m tall, apparently little-branched, epiphytic and pendulous; stems glabrous. *Leaves* opposite, subsessile or with *petiole* to 2 mm, glabrous; *blade* ovate, elliptic-ovate, or elliptic-oblong, 6–16 × 3–7.5 cm, glabrous, drying papery, base rounded to subtruncate, apex acute to usually acuminate; secondary veins 5 to 9 pairs, not or weakly uniting in a submarginal vein, tertiary venation not or sparsely visible; *stipules* triangular to pyramidal, 0.5–1 mm, succulent, glabrous, caducous. *Inflorescences* produced with leaves, shortly cymose to umbelliform or subfasciculate, 1–2 cm, glabrous, 3- to 6-flowered; peduncles 1 to 2 per axil, 4–6 mm, filiform; bracts reduced; pedicels 3–10 mm. *Flowers* with ovary portion ellipsoid, 1–1.2 mm, glabrous; *calyx* limb 0.3–0.5 mm, glabrous, lobed for 1/2–3/4, lobes narrowly triangular; *corolla* orange, yellow, or yellow-green, rotate, externally glabrous, tube ca. 1.5 mm, lobes triangular, ca. 2.2 mm, acute; mature anthers and stigmas not seen. Immature *fruits* ellipsoid, to 4 × 3 mm, mature color unknown.

Habitat, distribution, and phenology. Hoffmannia barbillana is known from wet forest at 300–400 m

on the Caribbean slopes of Costa Rica; it has been collected with flowers in August, September, and November.

IUCN Red List category. *Hoffmannia barbillana* is known from three collection localities and meets the geographic range criterion for Critically Endangered based on its small known Extent of Occurrence (EOO), but has more than the one location required for that designation; this species meets the geographic range criterion for Endangered based on its small AOO and not more than five different locations (i.e., distinct threat regimes). This species has been found in one legally protected area. *Hoffmannia barbillana* is described by collectors as epiphytic, so, as with many epiphytes, it may be undercollected and it may also be rare. The vegetation of the region is no doubt under threat at least outside the protected area, and due to its apparently limited distribution and possible local rarity, this species is here considered Endangered due to limited geographic distribution and habitat threat (EN B1ab[iii]+2ab[iii]).

Discussion. This new species can be recognized by its sessile or subsessile, generally ovate leaves; its rather short umbelliform to fasciculate-cymose inflorescences; its small yellow to orange corollas with the lobes longer than the tube; and its epiphytic habit. This is the first species of *Hoffmannia* described by field collectors as an epiphyte; all of the other known species of *Hoffmannia* are apparently terrestrial (i.e., rooted in soil). The type collection of *H. barbillana* is from Parque Nacional Barbilla, and the specific epithet refers to this locality. This new species is similar to *H. longipetiolata* Pol., but that species can be separated by its terrestrial habit and its petiolate leaves with blades that are broadest above the middle and acute to obtuse at the base.

Paratypes. COSTA RICA. **Cartago:** cantón Turrialba, Parque Nac. Barbilla, cuenca del Matina, sendero principal río abajo, *E. Mora & E. Rojas 1539* (CR, INB). **Limón:** cantón Siquirres, Las Brisas de Pacuarito, Reserva Ecol. Río Dantas, *G. Herrera 8729* (CR).

2. Hoffmannia boliviana C. M. Taylor, sp. nov. TYPE: Peru. Pasco: Oxapampa, dist. Pozuzo, Parque Nac. Yanachaga Chemillén, en parte alta del puesto de vigilancia Huampal hacia el límite del pajonal, 10°11′S, 75°34′W, 1225 m, 8 Apr. 2003, *A. Monteagudo, C. Mateo & G. Ortiz 4841* (holotype, USM; isotypes, HOXA, HUT, MO-6271351). Figure 2A, B.

Haec species a *Hoffmannia obovata* (Ruiz & Pav.) Standl. et *H. pearcei* Rusby petiolo longiore atque floribus minoribus, a *H. latifolia* (Bartl. ex DC.) Kuntze petiolo bene evoluto atque pubescentia hirtella carente, ab omnibus foliis latioribus distinguitur.

Subshrubs and shrubs to 2 m tall, perhaps little-branched; stems glabrous. *Leaves* opposite; *petioles* 10–70 mm, strigillose or puberulous becoming glabrescent; *blade* elliptic to obovate, 10–23 × 4–11.5 cm, adaxially glabrous and sometimes dark and appearing velvety, abaxially sparsely strigillose to puberulous and glabrescent, drying papery, base acute to attenuate, apex shortly and rather abruptly acuminate; secondary veins 10 to 13 pairs, looping to interconnect in a usually well-developed submarginal vein; tertiary venation well developed to not at all visible; *stipules* pyramidal to lingulate, 1–2 mm, succulent, strigillose to hirtellous, often spreading at 90° from stem. *Inflorescences* produced with leaves and along stem below leaves, cymose, dichasial, or often umbelliform, 1–4 cm, strigillose-hirtellous becoming glabrescent, 3- to 9-flowered; peduncles 1 to 3(4) per axil, 0.5–2 cm; bracts reduced; pedicels 3–7 mm. *Flowers* pedicellate; ovary portion ellipsoid to subglobose, ca. 2 mm, glabrous; *calyx* limb 0.8–1 mm, strigillose-hirtellous to glabrous, lobed for 1/3–3/4, lobes triangular to broadly triangular; *corolla* white, greenish yellow, or greenish white, externally glabrous, tube 1–1.5 mm, lobes ligulate to triangular, 1.5–2 mm, obtuse to acute; anthers 1–1.5 mm; stigmas clavate, ca. 1 mm. *Fruits* subglobose, 7–8 mm diam., becoming red then bright blue or purple.

Habitat, distribution, and phenology. *Hoffmannia boliviana* is known from wet and premontane forests at 200–1515 m from central Peru through central Bolivia; it has been collected in flower from October through June and in fruit usually concurrently, from September through June.

IUCN Red List category. *Hoffmannia boliviana* does not meet the geographic range criterion for any threatened category in its EOO, but meets the criterion for Endangered in its limited AOO based on the widely scattered collection localities. However, this species is known from more than 10 locations (i.e., different threat regimes), and it is found in five different legally protected areas in two countries across an elevational range of 1300 m and a linear geographic range of ca. 1600 km. It is apparently not uncommon locally, and survives or perhaps grows preferably in secondary vegetation. It is here assessed as Least Concern (LC).

Discussion. This new species can be recognized by its general lack of pubescence; its rather large leaves borne on well-developed petioles; its rather short, usually umbelliform inflorescences; its very small flowers; and its fruits that are broadly ellipsoid

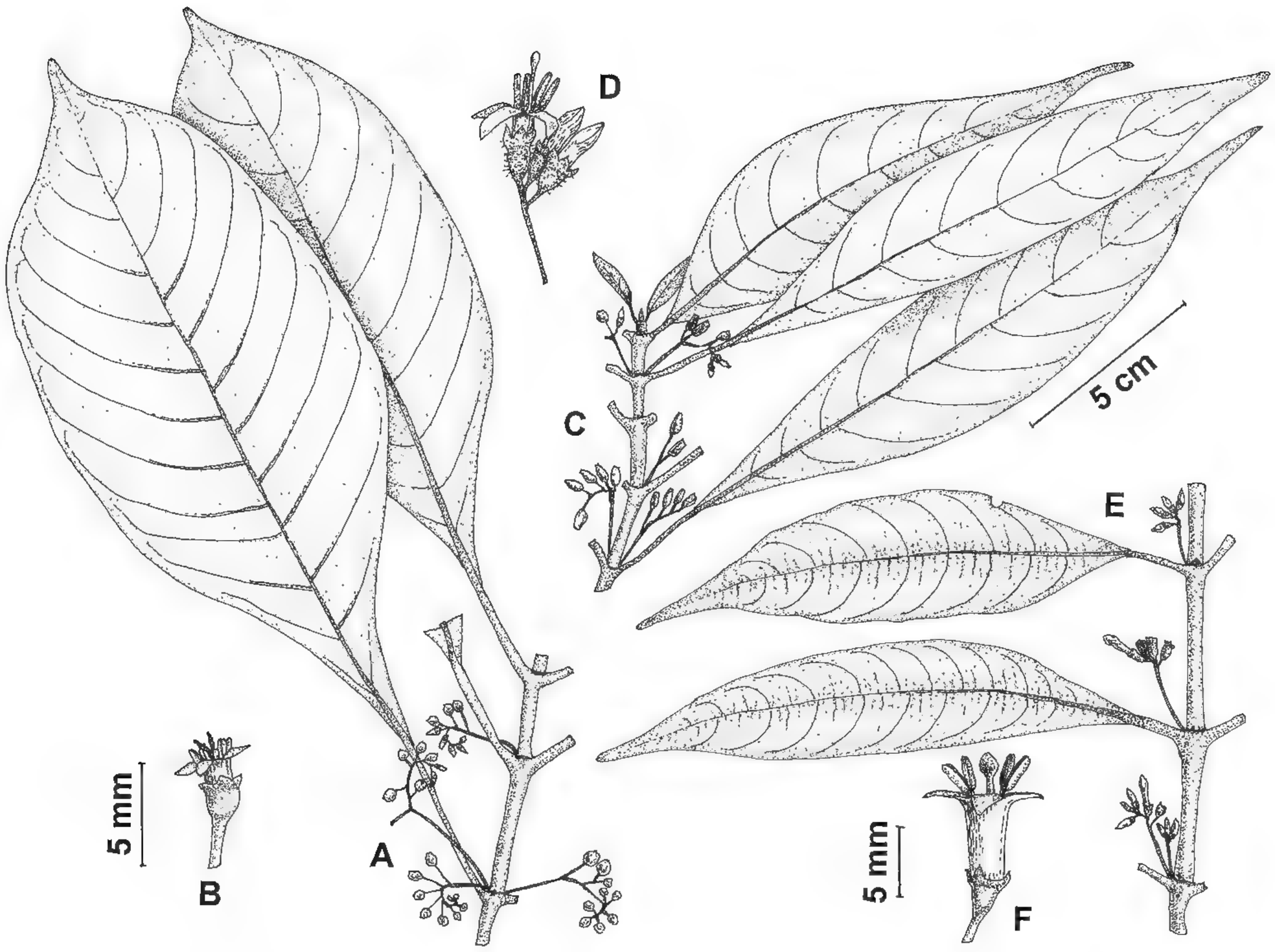

Figure 2. A, B. *Hoffmannia boliviana* C. M. Taylor. —A. Portion of fruiting stem; based on the paratype *Smith et al. 13198* (MO). —B. Flower; based on the type *Monteagudo et al. 4841* (MO). C, D. *H. rivalis* C. M. Taylor. —C. Portion of stem with inflorescence and young fruits; based on the type *Vásquez et al. 24071* (MO). —D. Portion of inflorescence with one flower at anthesis and two flower buds; based on the paratype *Rojas et al. 21* (MO). E, F. *H. coriacea* C. M. Taylor; based on the type *van der Werff et al. 17683* (MO). —E. Portion of flowering stem. —F. Flower. A, C, E drawn to same scale, indicated as 5 cm; D, F drawn to same scale, indicated as 5 mm.

to subglobose and bright blue to bright purple at maturity. Bright blue fruit color is rarely noted in *Hoffmannia*. Additionally the tertiary venation of the leaves is often rather sparsely visible. The specific epithet refers to its geographic distribution, with particularly good documentation from Bolivia.

Hoffmannia boliviana is similar to *H. obovata* (Ruiz & Pav.) Standl. and *H. pearcei* Rusby, which are also found from central Peru through central Bolivia (and may not be distinct from each other). These other two species can be recognized by their narrowly elliptic to oblanceolate leaves with the tertiary venation well developed and regularly reticulated; their generally shorter petioles (1–3 cm long); their generally yellow to red flowers; their corollas with longer tubes (2.5–3 mm long) that are longer than the corolla lobes, which are 3–6 mm long; and their fruits that are narrowly ellipsoid or ellipsoid-oblong and reported to be red or pinkish red. *Hoffmannia boliviana* is also similar to *H. latifolia* (Bartl. ex DC.) Kuntze, which is also found in the same region, but *H. latifolia* can be recognized by its hirtellous stems, leaves, and inflorescences; its narrowly oblanceolate leaves that are subsessile or borne on petioles generally only up to 5 mm long; its leaf blades with the tertiary and quaternary venation conspicuous and areolate; its white flowers; and its red, orange, or magenta fruits.

Paratypes. BOLIVIA. **Beni:** prov. Ballivián, Serranía Pilón Lajas, sobre la carr. Quiquibe Yucumo, 30 km al O de Yucumo en La Cumbre del Pilón, *T. Killeen & K. Smith 3619* (LPB, MO); Km 25 of rd., *C. Persson & C. Gustafsson 238* (MO, S); 21 km de Yucumo, *D. N. Smith, G. Quintana & V. García 13198* (LPB, MO); 14.3 km N of bridge over Río Quiquibey, *J. C. Solomon 13904* (LPB, MO); a 130 km de San Borja, *M. Moraes R. 667* (LPB, MO); provs. Ballivián y Yacuma, Est. Biol. del Beni, comun. Cero Ocho, *I. Guareco 4* (LPB, MO). **Cochabamba:** prov. Chapare, San Rafael, *R. F. Steinbach 513* (LPB, MO); Palmar Km 18, ca. del Río Kachimayu, *J. Teran, J. Altamirano & D. Soux 352* (BOLV, MO); Guacharos, *J. Teran, J. Altamirano & D. Soux 453* (BOLV, MO), *J. Teran, J. Altamirano & D. Soux 465* (BOLV, MO); a ca. 10 km de la est. San José, *J. Teran, E. Rodríguez & D. Soux 2687* (BOLV, MO). **La Paz:** prov. Nor Yungas, Suapi, subiendo el Río Suapi, *S. Beck 30354* (LPB, MO); prov. Sud Yungas, Río Quiquibey, barranca del Río San Luis, *S. Beck 8094* (LPB, MO); Alto Beni concesión de

la coop. Sapecho, *R. Seidel, M. Humaday & X. Aramayo 5703* (LPB, MO); ca. de la Colonia Cascada, *R. Seidel, X. Villavicencio, A. Acebey & T. Krömer 8305* (LPB, MO). **Santa Cruz:** prov. Ichilo, Parque Nac. Amboró, along Río Sanguayo 1 km NE of entrance into first Andean foothills, *M. Nee & M. Saldías 35952* (MO, NY); 10.5 km SO (línea recta) de Huaytí, *M. Saldías P. 503* (MO, SCZ). PERU. **Huánuco:** prov. Leoncio Prado, 80 km NE of Tingo María toward Agaytia near La Divisora, *A. Gentry, J. Revilla & J. Schunke V. 16000* (MO). **Pasco:** prov. Oxapampa, dist. Villa Rica, centro poblado Palma (Centro Bocaz), camino a Alta Atarraz, *L. Franco Mellado, E. Ortiz V., J. Mateo & R. Francis 2490* (HUT, MO); Gran Pajonal, trail betw. Chequitavo & Shumahuani, *D. N. Smith 6621* (MO).

3. Hoffmannia coriacea C. M. Taylor, sp. nov. TYPE: Peru. Pasco: Oxapampa, Chacos, 10°37′N, 75°17′W, 22 June 2003, *H. van der Werff, R. Vásquez, B. Gray, R. Rojas, R. Ortiz & N. Davila 17683* (holotype, USM; isotypes, HOXA, HUT, MO-6271352). Figure 2E, F.

Haec species a congeneris foliis subcoriaceis coriaceisve sat angustis atque corollae tubo lobis fere bis longiore distinguitur.

Subshrubs or shrubs to 2 m tall, apparently branched; stems glabrous. *Leaves* opposite; *petioles* 0.5–1.8 cm, glabrous; *blade* narrowly elliptic to narrowly oblanceolate, 6.5–18 × 1.8–5 cm, glabrous, drying subcoriaceous or coriaceous, apparently often pale abaxially, base acute, apex acute to acuminate; secondary veins 8 to 12 pairs, usually weakly looping to interconnect in a submarginal vein, tertiary venation generally developed; *stipules* pyramidal, 2–3 mm, succulent, glabrous, often spreading at ca. 90° from stem. *Inflorescences* produced with leaves, cymose and usually dichasial, 2–4 cm, glabrous, 3- to 11-flowered; peduncles 1 to 2 per axil, 0.5–1.5 cm; bracts reduced or few, ligulate, to 1 mm; pedicels 1–5 mm. *Flowers* pedicellate; ovary portion ellipsoid to obconic, ca. 2 mm, glabrous; *calyx* limb 1.5–2 mm, glabrous, lobed nearly to base, lobes triangular; *corolla* yellow or pale yellow sometimes flushed with red, externally glabrous, tube 5–6 mm, lobes lanceolate or triangular, 3–3.2 mm, obtuse to acute; anthers 2.5–3 mm; stigmas lanceolate, 1–1.2 mm. *Fruits* subglobose, 7–8 mm, red.

Habitat, distribution, and phenology. Hoffmannia coriacea is known from montane forest, at least sometimes on sandstone-derived soils, at 2100–2500 m in central Peru; it has been collected in flower from June through October and in fruit in June.

IUCN Red List category. Hoffmannia coriacea meets the geographic range criterion for Critically Endangered due to its restricted EOO, and for Endangered due to its small AOO and only two locations (i.e., different threat regimes). It is found in one legally protected area, and also outside but very close to that protected area. The habitat condition of these locations is not well documented, but certainly habitat decline is likely in the future at least outside the park. However, this general region is poorly explored, and *H. coriacea* may be more widely distributed than is now known. Therefore, it is considered Vulnerable due to limited range (VU D2), although if its habitat were known to be declining it would be considered Endangered.

Discussion. This new species can be recognized by its stiff-textured, relatively narrow leaves and its well-developed yellow corollas with the tube almost twice as long as the lobes. The specific epithet refers to the leathery leaf texture, which is unusual in *Hoffmannia*. Some specimens have diseased fruits (*Vásquez et al. 32846*, *Rojas et al. 2664*), and the flowers of these collections also lack anthers; it seems likely that this unusual flower morphology is related to the plant's infection.

Hoffmannia coriacea is similar to *H. obovata*, which is found in the same region in central Peru; however, *H. obovata* as well as most other Peruvian *Hoffmannia* species can be separated by their corollas with the tube shorter than the lobes. One species found in central Peru, *H. subauriculata* Standl., does have corollas that are similar in size and form to those of *H. coriacea*, but *H. subauriculata* is known only from lower elevations, at 700–1850 m, and can be recognized by its subsessile or very shortly petiolate leaves that are rounded to cordulate at the base.

Paratypes. PERU. **Pasco:** Oxapampa, Cordillera Yanachaga, 12 km SE of Oxapampa, rd. over shoulder of Cerro Pajonal to Villa Rica drainage, *R. Foster & D. Smith 9078* (MO); zona del amortiguamiento del Parque Nac. Yanachaga-Chemillén, Sector Chacos, *A. Monteagudo, J. Mateo, L. Chuck & A. Alvares 15033* (HUT, MO), *R. Rojas, M. Huaman, A. Peña, J. Mateo & C. Rojas 2664* (HUT, MO), *H. van der Werff, R. Vásquez, B. Gray, R. Ortiz & N. Davila 18657* (HUT, MO), *R. Vásquez, G. Castillo, V. Flores & L. Hernani 32846* (HUT, MO).

4. Hoffmannia costaricensis C. M. Taylor, sp. nov. TYPE: Costa Rica. San José: along Quebrada Tablazo & forested slopes above creek, NE part of Altos Tablazo, 9°50′N, 84°03′W, 1700–1800 m, 23 Apr. 1985, *M. Grayum & G. Schatz 5154* (holotype, CR; isotype, MO-05007140). Figure 1E, F.

Haec species a *Hoffmannia valerioi* Standl. lamina foliari oblanceolata usque obovata, petiolo et lobis calycinis brevioribus atque lobis corollinis longioribus distinguitur.

Shrubs to 3 m tall, perhaps little-branched; stems densely tomentulose or pilosulose-hirtellous. *Leaves* opposite, subsessile or with *petioles* to 18 mm, densely tomentulose; *blade* oblanceolate to obovate, 9.5–25 × 2.5–8 cm, adaxially glabrous or sparsely pilosulose near margins, abaxially moderately to densely puberulous to tomentulose on principal veins and puberulous to sparsely pilosulose on lamina, drying papery, base acute to attenuate, apex acute; secondary veins 8 to 12 pairs, free, extending to margins, or sometimes weakly uniting in a looping submarginal vein, tertiary venation regularly visible; *stipules* broadly triangular to pyramidal, 2–3 mm, succulent, densely tomentulose, apparently glandular at apex, deciduous. *Inflorescences* produced at 8th through 10th nodes below leaves and sometimes also in 1 to 3 basalmost (i.e., lowermost) nodes with leaves, cymose and generally dichasial, 1.5–2 cm, densely puberulous to tomentulose, 3- to 7-flowered; peduncles 1 to 3 per axil, 3–11 mm; bracts reduced; pedicels 1–2 mm. *Flowers* pedicellate; ovary portion obconic-ellipsoid, 1.2–1.5 mm, tomentulose-puberulous; *calyx* limb 0.8–1 mm, tomentulose-puberulous, lobed for 1/2–3/4, lobes triangular to broadly triangular; *corolla* greenish yellow or pale yellow, rotate, externally puberulous-hirtellous, in bud with tube to 3 mm, lobes narrowly triangular, to 7 mm; mature anthers and stigmas not seen. *Fruits* subglobose, ca. 5 mm, red.

Habitat, distribution, and phenology. *Hoffmannia costaricensis* is known from wet premontane and montane forest at 1500–2200 m in central Costa Rica; it has been collected with flowers April through June and with fruits in December.

IUCN Red List category. *Hoffmannia costaricensis* meets the geographic range criterion for Endangered based on its limited EOO, its limited AOO, and its five (at most) locations (i.e., different threat regimes). It is found in two legally protected areas; however, the habitat of these areas is in decline and the habitat outside these areas is in significant decline. This species is here considered Endangered due to limited geographic range and habitat threats (EN B1ab[iii]+2ab[iii]).

Discussion. This new species can be recognized by the combination of its dense tomentulose or pilosulose-hirtellous pubescence on the stems and stipules, its oblanceolate or obovate leaves, its short inflorescences borne mostly or all along the stems below the leaves, and its small yellowish green or pale yellow corollas with the lobes significantly longer than the tube. This new species is known only from the mountains of central and northern Costa Rica; the specific epithet refers to its distribution entirely within this country.

These plants were previously included in *Hoffmannia decurrens* Standl. (Burger & Taylor, 1993), but that name is here considered a synonym of *H. arborescens* Donn. Sm. *Hoffmannia arborescens* is also found in montane habitats of Costa Rica, but can be separated from *H. costaricensis* by its corollas with longer tubes, 7–12 mm long, and the tubes longer than the lobes. *Hoffmannia costaricensis* is also similar in Costa Rica to *H. valerioi* Standl., but *H. valerioi* is found predominantly at lower elevations, 50–1500 m, and can be recognized by its elliptic to elliptic-oblong leaf blades that are widest at or a little below the middle, its inflorescences borne with the leaves or at only one or two stem axils below the basalmost pair of leaves, and its longer calyx lobes, 1–5 mm long.

Paratypes. COSTA RICA. **Cartago:** Cerro La Carpintera, immediately N of Tres Ríos & E of San José, *C. M. Taylor 3866* (DUKE). **San José:** Cerro Pico Blanco, 4 km S of Escazú, *R. W. Lent 3984* (MO); cantón de Aserrí, Cerros de Escazú, cuenca del río Suárez, *J. F. Morales & R. J. Abarca 1812* (INB, MO); ca. 5 km from Panamerican Hwy. in Talamancas, along rd. to Copey, *C. M. Taylor 3103* (DUKE).

5. Hoffmannia formicaria C. M. Taylor, sp. nov. TYPE: Costa Rica. Limón: cantón de Limón, El Progreso, Fila Matama, Valle de La Estrella, siguiendo el sendero de la avioneta, por la fila hasta los 1700 m, 9°47′N, 83°09′W, 1350 m, 19 Apr. 1989, *G. Herrera & A. Chacón 2660* (holotype, CR; isotype, MO-3840515). Figure 3A, B.

Haec species a *Hoffmannia morii* Dwyer habitu humili, inflorescentia pedunculata congesta usque laxe cincinnata, floribus pedicellatis atque corolla alba luteoviridi roseave intus saepe lineolata distinguitur.

Herbs or subshrubs flowering at 0.3–1 m tall, generally unbranched; stems densely villous or hirsute-tomentose, sometimes eventually becoming glabrescent, trichomes often flushed with red or purple. *Leaves* opposite; *petiole* (i.e., below vesicles) 2–15 mm, densely villous, hirsute, or tomentose-hirsute; *blade* elliptic, elliptic-oblong, or obovate, 5.5–23 × 3.5–11 cm, adaxially sparsely to moderately hirsute or hirtellous, abaxially hirsute, villous, or hirtellous with pubescence denser on principal veins, drying papery, base cuneate to truncate and abruptly narrowed with a pair of ellipsoid vesicles 1–2.5 × 0.7–1 cm, apex obtuse to acute or acuminate; secondary veins 8 to 14 pairs, free or sometimes weakly looping to interconnect, tertiary venation well

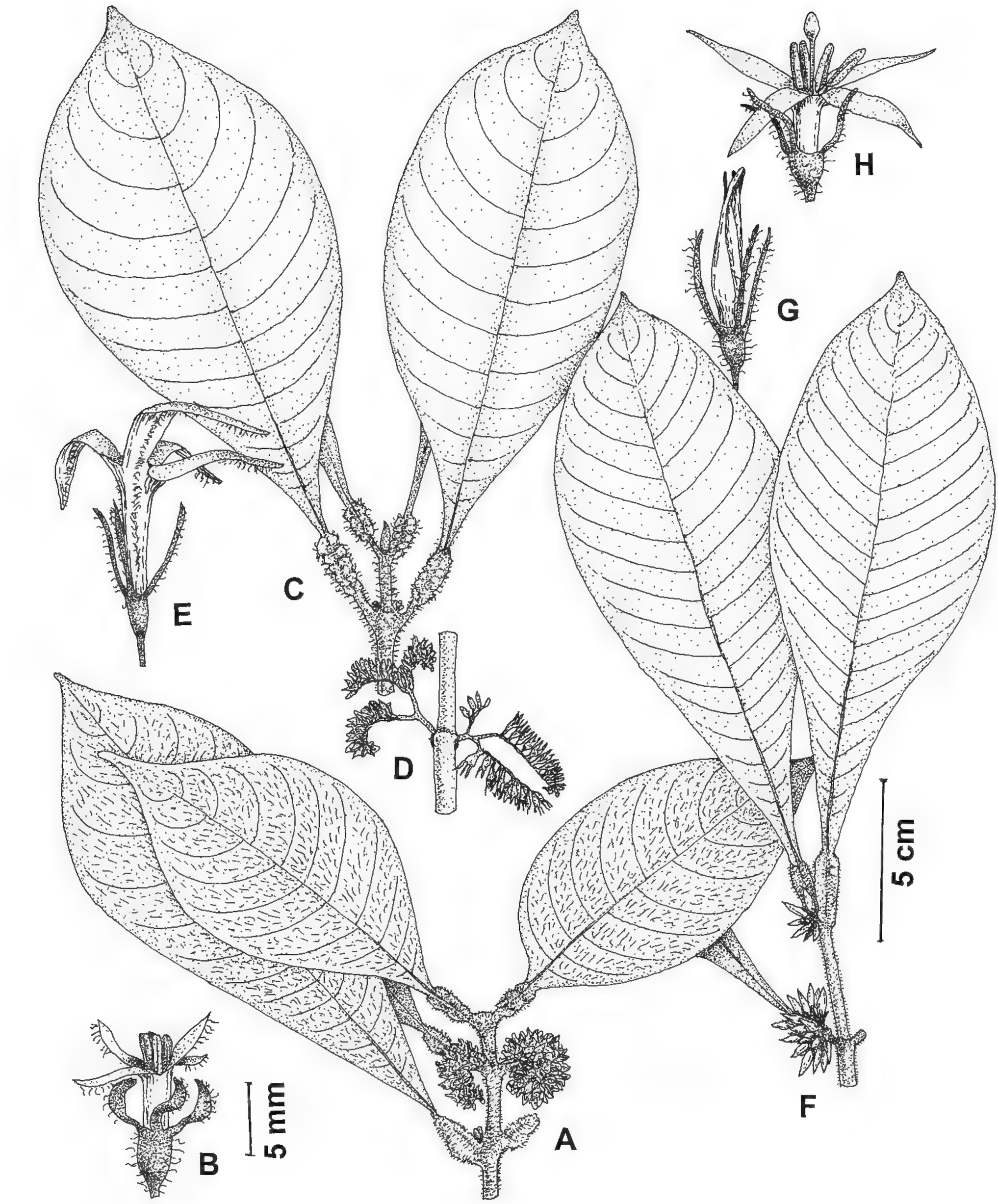

Figure 3. Some vesiculate species of *Hoffmannia*. A, B. *H. formicaria* C. M. Taylor. —A. Portion of flowering stem; based on the type *Herrera & Chacón 2660* (MO). —B. Flower; based on the paratype *McPherson 12285* (MO). C–E. *H. pseudovesiculifera* C. M. Taylor. —C. Apical portion of stem. —D. Portion of stem below leaves with infructescence. C, D based on the paratype *Correa et al. 3179* (MO). —E. Flower; based on the paratype *Antonio 3083* (MO). F–H. *H. limonensis* C. M. Taylor; based on the paratype *Mora 1059* (MO). —F. Portion of flowering stem. —G. Flower bud. —H. Flower at anthesis. A, C, D, F drawn to same scale, indicated as 5 cm; B, E, G, H drawn to same scale, indicated as 5 mm.

developed; *stipules* narrowly triangular or narrowly ligulate, 2–4 mm, hirsute or villous. *Inflorescences* produced in axils of leaves, congested to laxly cincinnate, 1.5–3 cm, densely hirsute or villous, many-flowered, sessile or with peduncles 1 to 2 per axil, to 1 cm; bracts reduced; pedicels 2–4 mm. *Flowers* pedicellate; ovary portion ellipsoid to obovoid, 1–1.5 mm, glabrescent; *calyx* limb divided nearly to base, hirsute or villous, lobes narrowly triangular to linear, 2.5–4 mm; *corolla* white, greenish yellow, or pink, often internally marked with red or brown lines, rotate or rotate-salverform,

externally glabrous except villosulous to hirsute on upper part of lobes and/or along middle of lobes, tube 4–5 mm, lobes narrowly triangular, 5–7 mm, sharply acute; anthers ca. 3 mm; stigmas ovoid, ca. 1 mm. *Fruits* ellipsoid, 7–10 mm, red.

Habitat, distribution, and phenology. *Hoffmannia formicaria* is known from wet, premontane, and montane forests at 700–1900 m on the Caribbean slopes of Costa Rica and western Panama; it has been collected in flower March through May and in August and in fruit in February, March, November, and December.

IUCN Red List category. *Hoffmannia formicaria* meets the geographic range criterion for Vulnerable based on its limited EOO, and for Endangered based on its small AOO. However, there are apparently more than 10 locations (i.e., different threat regimes), and this species is found in eight legally protected areas in two countries. *Hoffmannia formicaria* seems to be locally common, but to inhabit a rather narrow ecological and elevational zone; within this zone, there are some areas that are well preserved and protected, but some that are in habitat decline. Because the number of locations of this species could fall below 10 due to habitat destruction in the near future, this species is here considered Near Threatened (NT).

Discussion. This new species can be recognized by its low habit; its dense, often red or purple, villous to hirsute-tomentose pubescence; its shortly petiolate leaves of moderate size with paired vesicles at the base; its short cincinnate inflorescences; its well-developed calyx lobes; and its corollas with the sharply acute lobes a little longer than the tube. The specific epithet refers to the leaf vesicles or formicaria, which are distinctive, though not unique to this species. Ants are sometimes reported to inhabit the vesicles (*Stevens 13571*, MO), but sometimes are not present (*Knapp 5096*, MO).

This new species is similar to *Hoffmannia morii*, found in the same region in Panama; however, *H. morii* differs in its larger habit, with the plants usually flowering at 1 m tall or more; its sessile to subsessile, capitate, subcapitate, or densely congested-cymose inflorescences with the axes not developed and the flowers generally sessile (although sometimes the fruits are borne on pedicels that elongate after flowering); its calyx lobes with the apices usually thickened, a little curved, and densely pubescent; and its corollas that are bright yellow to orange. *Hoffmannia formicaria* is also similar to *H. vesiculifera*, which is also found in the same region in Panama, but *H. vesiculifera* can be recognized by its rounded-corymbiform or clearly dichasial inflorescences with one to three pairs of enlarged foliaceous bracts, its longer calyx lobes (10–17 mm long), and its corollas with the tube 13–14 mm long and at least twice as long as the lobes. *Hoffmannia formicaria* is also similar to *H. limonensis* C. M. Taylor and *H. veraguensis* C. M. Taylor, which are both described and distinguished later in this article.

Paratypes. COSTA RICA. **Alajuela:** cuenca del Sarapiquí, Virgen del Socorro, *R. Kriebel 569* (INB); along rd. Colonia Virgen del Socorro, barranca Río Sarapiquí, *W. D. Stevens 13571* (CR, MO). **Cartago:** Refugio Nac. Vida Silvestre Tapantí, *L. D. Gómez 18904* (MO), *R. Kriebel 1961* (INB); S Tapantí along rd. along E slope above Río Grande de Orosi, *W. Burger & R. G. Stolze 5660* (DUKE, F), *W. Burger & R. Liesner 6848* (CR, F, MO); Sendero Oropendula, *P. Delprete 5303* (CR, MO; sterile); Valle del Reventazón, Río Humo, Alto Patillos, *J. F. Morales & V. H. Ramírez 5042* (INB, MO); cantón Paraíso, Parque Nac. Tapantí-Macizo de la Muerte, cuenca del Reventazón, alrededores del túnel, *A. Rodríguez 5844* (INB); cuenca del Reventazón, Kiri Lodge, Sendero Colibrí, Orosi, *R. Kriebel 1338* (INB); cantón Jiménez, cuenca del Reventazón, Refugio Vida Silvestre La Marta, *D. Solano, A. Solano & R. Kriebel 165* (INB); Parque Nac. Tapantí, *A. Weissenhofer 3653* (CR, WU); sector Quebrada Segunda, *G. Mora 426* (INB); Río Grande de Orosi, 8 km S Tapantí, *R. Lent 911* (CR); Canton Turrialba, Parque Nac. Barbilla, cuenca del Matina, Sendero Barthon, Seccion Corina-Tigre, *E. Mora, R. Barton Salazar & F. Umana Salazar 1837* (INB); Tayutic, Jicotea, altos entre río Jicotea & río Vereh, *G. Herrera & I. Martínez 8027* (CR); cantón Jiménez, cuenca del Río Pejibaye, La Selva, Albergue el Copal, sendero el Ron Ron, *D. Santamaría, D. Solano & D. Martínez 2166* (INB). **Guanacaste:** cantón Tilarán, Cordillera de Guanacaste, Zona Parque Tenorio, Tierras Morenas, cabeceras del Río San Lorenzo, *G. Rodríguez 292* (INB, MO). **Heredia:** Parque Nac. Braulio Carrillo, from park entrance at El Ceibo hike 4 hr. to Casa 1070 then 1 hr. N, *A. Gilman 102* (INB, MO). **Limón:** cerro entre Cerros Chimú y Matama, *L. D. Gómez & G. Herrera 23543* (CR, MO); El Progreso, Fila Matama, Valle de La Estrella, cabeceras del Río Cariei, *G. Herrera & A. Chacón 2793* (CR, MO); Filas al E Almirante, cuenca superior río Boyei, rumbo Fila Matama, *G. Herrera 8518* (CR); cantón Talamanca, Parque Nac. La Amistad, cuenca del Sixaola, *D. Solano 3970* (INB), *D. Solano & A. Rodríguez 4198* (INB); Río Coén, *D. Santamaría 5811* (INB); Bratsi, entre Ujarrás y San Jose Cabécar, *A. Rodríguez & D. Solano 11065* (INB); cantón Limón, Zona Parque Río Banano, cuenca del Banano, Valle de La Estrella, Fila Matama, ca. 11 km SW del pueblo de Aguas Zarcas, *D. Solano, A. Rodríguez, B. Gamboa R., D. Santamaría, E. Boza, M. Hernández Peña, M. Moraga, O. Chacón Chavarría & R. Delgado Dávila 4796* (INB). **San José:** Bajo La Hondura, *H. Kennedy & P. DeVris 3815* (CR); río Bajo La Hondura, Parque Nac. Braulio Carrillo, 25 km N de San José, *M. Sousa, L. D. Gómez, G. Davidse, C. Humphries, R. Hampshire, N. Garwood & M. Gibby 12669* (CR). PANAMA. **Bocas del Toro:** Fortuna Dam or IRHE Fortuna Hydroel. Project area, oleoducto rd. near cont. divide, *H. Churchill, G. de Nevers & H. Stockwell 4691* (MO); oleoducto rd. ca. 1 km N of Quebrada Arena, *S. Knapp 5096* (MO); on trail along cont. divide, *G. McPherson 12285* (MO); Caribbean slopes of Cerro Fábrega at foot of

"Falso Fábrega" in Palo Seco Reserve, N tributary (on map) of Culubre River, Pavón Camp, *A. Monro & S. Cafferty 4738* (INB); faldas del "Cerro Falso Fábrega," PILA, punto 13, *D. Santamaría, D. Solano, N. Zamora, A. K. Monro & A. Solís 7719* (INB); Changuinola, PILA, *A. De Sedas Martínez & D. Solano 691* (INB); ca. 2 km from est. Alto Uri, *D. Santamaría, A. K. Monro & J. Lezcano 7402* (INB); Cerro Frio, headwaters of Río Pskui, Point 23, *D. Santamaría, A. Monro & L. Martínez 7885* (INB). **Bocas del Toro/Chiriquı border region:** along rd. betw. Fortuna & Chiriquí Grande, 4.5 8.5 mi. N of bridge over Fortuna Dam, near cont. divide, *T. Croat & M. Grayum 59995* (MO), *T. Croat & M. Grayum 60182* (MO), *T. Croat & M. Grayum 60432* (MO). **Chiriquí:** La Fortuna or IRHE Hydroel. project, S side of river, *B. Hammel 2042* (MO); N of Carr. Oleoducto, Quebrada de Arena, *S. Knapp, W. J. Kress & B. Hammel 4073* (MO); ridge 8 km N of Los Planes de Hornito, *S. Knapp 5002* (MO); above Gualaca, *G. McPherson 6701* (MO); dist. Gualaca, correg. Hornito, Reserva Forestal Fortuna (STRI), *J. L. Clark & L. Espinosa 8563* (MO, US).

6. Hoffmannia limonensis C. M. Taylor, sp. nov. TYPE: Costa Rica. Limón: Reserva Biol. Hitoy Cerere, siguiendo la fila entre Río Hitoy y Río Cerere, 9°39′N, 83°06′W, 300 m, 26 Feb. 1989, *G. Herrera & M. Solís 2462* (holotype, CR; isotype, DUKE-334110, MO-3761357). Figure 3F–H.

Haec species a *Hoffmannia vesiculifera* Standl. corollae lobis 10–14 mm longis acutis usque acuminatis apiculatisve tubo longioribus distinguitur.

Subshrubs or shrubs to 3 m tall, perhaps little-branched or unbranched; stems densely villous or tomentose-hirsute with uniseriate trichomes 1–2 mm. *Leaves* opposite; *petiole* (i.e., below vesicles) 2–15 mm, densely villous or tomentose-hirsute; *blade* elliptic to obovate, 17–36 × 7–17 cm, adaxially sparsely to densely hirsute on blade and sometimes veins, abaxially densely puberulous to hispidulous along principal veins and sparsely to moderately hirtellous along higher-order veins and sometimes also on lamina, drying papery, base cuneate to acute or attenuate then with a pair of ellipsoid vesicles 1.5–3 × 0.5–1 cm, apex acuminate; secondary veins 14 to 19 pairs, not or weakly looping to interconnect in apical part of blade, tertiary venation well developed; *stipules* narrowly triangular, 4–10 mm, somewhat succulent, densely villous or hirsute. *Inflorescences* produced with leaves, subcapitate to glomerulate or densely congested-cymose, densely hirsute or villous, many-flowered, sessile, subsessile, or with peduncle 1 per axil, to 1.2 cm; heads or cymes subglobose or rounded, 2–3.5 cm diam., usually enclosed by 2 to 4 foliaceous bracts 1–3 × 0.8–2 cm, ovate to lanceolate; remaining bracts linear to narrowly triangular, 4–10 mm; pedicels to 3 mm. *Flowers* sessile or pedicellate; ovary portion obconic, ca. 2.5 mm, villous or hirsute to glabrescent; *calyx* limb divided nearly to base, lobes linear, 4–7 mm, sparsely hirsute or villous in apical portion with trichomes 1–1.5 mm; *corolla* yellow to orange, rotate, glabrous externally, tube 4–5 mm, lobes lanceolate, 10–14 mm, acute to acuminate or apiculate; anthers narrowly lanceolate, ca. 7 mm; stigma ovoid, ca. 1.5 mm. *Fruits* ellipsoid, ca. 8 mm diam., red.

Habitat, distribution, and phenology. *Hoffmannia limonensis* is known from wet and premontane forests at 200–900 m on the Caribbean slopes of Costa Rica and western Panama; it has been collected in flower February through May and in fruit in October.

IUCN Red List category. *Hoffmannia limonensis* meets the geographic range criterion for Endangered based on its limited EOO and AOO, but there are more than 10 locations (i.e., different threat regimes). This species is known in six legally protected areas in two countries. *Hoffmannia limonensis* seems to be locally rather common and to inhabit a rather narrow ecological and elevational zone; within this zone, it is found in several areas that are well preserved and protected, but also in a few that are in decline. If some of the subpopulations in unprotected and declining areas were to be eliminated, this species would fall to very close to 10 or fewer locations and it is here considered Near Threatened (NT).

Discussion. This species can be recognized by its densely villous to tomentose-hirsute pubescence; its well-developed leaves with paired elongated vesicles at the base; its capitate to congested, sessile to shortly pedunculate, densely pubescent inflorescences that are sometimes enclosed by one or two pairs of foliaceous bracts; its well-developed linear calyx lobes; and its yellow to orange corollas with the well-developed lobes longer than the tube and narrowed to usually prolonged tips. This new species is known from the Caribbean coast of Costa Rica through western Panama, but has been most often collected with the most complete specimens in Limón Province, Costa Rica; the specific epithet refers to this locality. On the specimens studied, the tips of the corolla lobes are usually spreading in bud, but this may be an artifact of drying. The label data of some collections (*Liesner et al. 15408, 15451*; *de Nevers 4098*) report the presence of ants in the leaf vesicles, but those of other specimens report no ants (*Lent 529*). The fully developed flowers studied appear to have only one rather large ovoid stigma, which may be formed of two stigmas that are not spreading.

Hoffmannia limonensis is similar to *H. vesiculifera* of Panama; *H. vesiculifera* can be recognized by its

generally smaller leaves (15–25 × 6–10 cm), its inflorescences borne on generally longer peduncles (1–4 cm long), and its corollas with longer tubes (13–14 mm long) and shorter lobes (6–10 mm long). *Hoffmannia limonensis* is also similar to *H. formicaria*, described previously in this article and found in the same general region; *H. formicaria* can be separated by its generally smaller leaves, its pedunculate cincinnate inflorescences, its shorter calyx lobes, and its white, greenish yellow, or pink corollas with shorter lobes.

Paratypes. COSTA RICA. **Cartago:** 13 km E of Turrialba on hwy. Limón, canyon Río Chitaría, *R. Liesner, E. Judziewicz & B. Pérez G. 15408* (CR, MO); cantón Turrialba, Reserva Biol. Barbilla, cuenca del Matina, sendero Valle Escondido, *E. Mora C., L. Pacheco & A. Rojas 263* (CR, INB, MO); Parque Nac. Barbilla, cuenca del Matina, Sendero Quebrada, *E. Mora & E. Rojas 1585* (INB); vera del río Chitaría, ca. del puente carr. Siquirres, Turrialba, *J. Gómez-Laurito 684* (CR), *J. Gómez-Laurito 6817* (CR); Finca Tres Equis, Chitaría, Turrialba, *C. H. Lankester L-21* (CR). **Limón:** ridge separating Quebrada Cañabral from Río Barbilla & slope leading to latter, *M. Grayum, G. Herrera & R. Robles 8757* (CR, MO); betw. headwaters Río Madre de Dios & Quebrada Barreal, *M. Grayum, G. Herrera & R. Robles 8800* (CR, MO); betw. Cerro Jacrón & Cerro Bitárkara, trail betw. "Sitio Rangale" & Cuen, *D. Hazlett 5135* (CR, MO); along hwy. C.R. 233, 8 km N of Tres Equis, *R. Lent 529* (MO); 37 km NE of Turrialba on hwy. Limón, 8 km N of Linda Vista, *R. Liesner, E. Judziewicz & B. Pérez G. 15451* (CR, MO); Matina, Parque Nac. Barbilla, cuenca del Matina, sendero Las Pitas, Quebrada El Dulce, *E. Mora 1059* (CR, INB, MO); cantón Limón, Río Segundo, Asunción, *L. D. Gómez & G. Herrera 23499* (CR, MO); Faja Costeña de Limón, La Bomba, La Asunción, aguas arriba Río Banano, Fila Asunción, *Q. Jiménez, A. Rodríguez & A. Estrada 1832* (CR, INB, MO); cantón Talamanca, Amubri, camino entre Amubri & Soki, cabeceras del Río Ñabri, *G. Herrera 3137* (CR, MO); Bratsi, Alto Lari, siguiendo fila entre Río Dapari & Río Lari, *G. Herrera 5170* (CR, INB, MO); Parque Nac. La Amistad, cuenca del Sixaola, *A. K. Monro & D. Santamaría 5702* (INB), *D. Santamaría, A. Monro, M. Moraga & B. Gamboa R. 5948* (INB); Fila Buhu, *D. Santamaría, A. Monro, B. Gamboa R. & M. Moraga 5976* (INB); camp by Kivut, trail up from camp & 4 km SW, *J. Bittner 1556* (CR, INB); Reserva Indígena Talamanca, Alto Urén, *G. Gallardo 93* (INB); Siquirres, Barbilla, entre Quebrada Jesús & Quebrada San Miguel ruta Cerro Tigre, *G. Herrera & G. Valvarde Matamoros 8833* (CR). PANAMA. **Panamá:** headwaters of Río Chagres, Río Esperanza & Río Piedras, *G. de Nevers 4098* (MO).

7. Hoffmannia micrantha C. M. Taylor, sp. nov. TYPE: Costa Rica. Puntarenas: cantón de Osa, Fila Costeña, Fila Cruces, N of headwaters of Río Piedras Blancas, W slope of Cerro Angucigana, 8°49′N, 83°11′W, 950–1400 m, 8 Dec. 1993, *M. Grayum, B. Hammel, R. Aguilar & J. Gómez 10616* (holotype, CR; isotypes, INB, MO-04886290). Figure 4D, E.

Haec species a *Hoffmannia hammelii* C. M. Taylor foliis plerumque majoribus venatione tertiaria haud vel vix manifesta atque corolla aurantiaca brunnea purpureave distinguitur.

Subshrubs or shrubs to 4 m tall, branched; stems hirtellous or villosulous to glabrous. *Leaves* opposite; *petioles* 10–60 mm, hirtellous or villosulous to glabrous; *blade* elliptic or elliptic-obovate, 9–34 × 3.5–12.5 cm, adaxially glabrous, abaxially glabrous or villosulous to hirtellous along principal veins, drying papery, base obtuse to acute or attenuate, apex acute to acuminate; secondary veins 6 to 13 pairs, looping to interconnect in a weak to well-developed undulate submarginal vein, tertiary venation developed; *stipules* pyramidal to ovoid, 1–2 mm, succulent, strigillose quickly becoming glabrescent, deciduous. *Inflorescences* produced with leaves and extensively along stems below leaves, scorpioid-racemiform to cincinnate and usually secund, slender, puberulous or strigillose to glabrescent, 4- to 12-flowered; peduncles 1 to 3 per axil, 1–1.5 cm; bracts reduced; pedicels 2–6 mm. *Flowers* pedicellate; ovary portion ellipsoid to obovoid, 1.2–1.5 mm, strigillose or puberulous to glabrous; *calyx* limb 0.5–0.8 mm, puberulous to glabrous, lobed for 1/4–3/4, lobes broadly triangular to rounded; *corolla* orange, dull yellow-orange, brown, tan, or dull purple, salverform, externally glabrous or puberulous, tube 2–3 mm, lobes triangular, 2.5–4 mm, acute; stamens and stigmas not seen. *Fruits* subglobose, ca. 5 mm diam., greenish becoming white, then red, then at least sometimes purple.

Habitat, distribution, and phenology. Hoffmannia micrantha is known from wet and premontane forest at 150–1400 m in the Golfito and Osa Peninsula regions of southern Costa Rica; it has been collected in flower from June through August and in December and in fruit in September, October, and December.

IUCN Red List category. Hoffmannia micrantha meets the geographic range criterion for Endangered based on its limited EOO and AOO, but only qualifies as Vulnerable due to its more than five but not more than 10 locations (i.e., different threat regimes). It is found in three legally protected areas, and is in general an endemic of a relatively small region of southern Costa Rica; other species are known with similar distribution, so this is probably an accurate general outline of its range. Several of the known locations of *H. micrantha* are reasonably well preserved and protected, but others are certainly in decline. Therefore, this species is considered Vul-

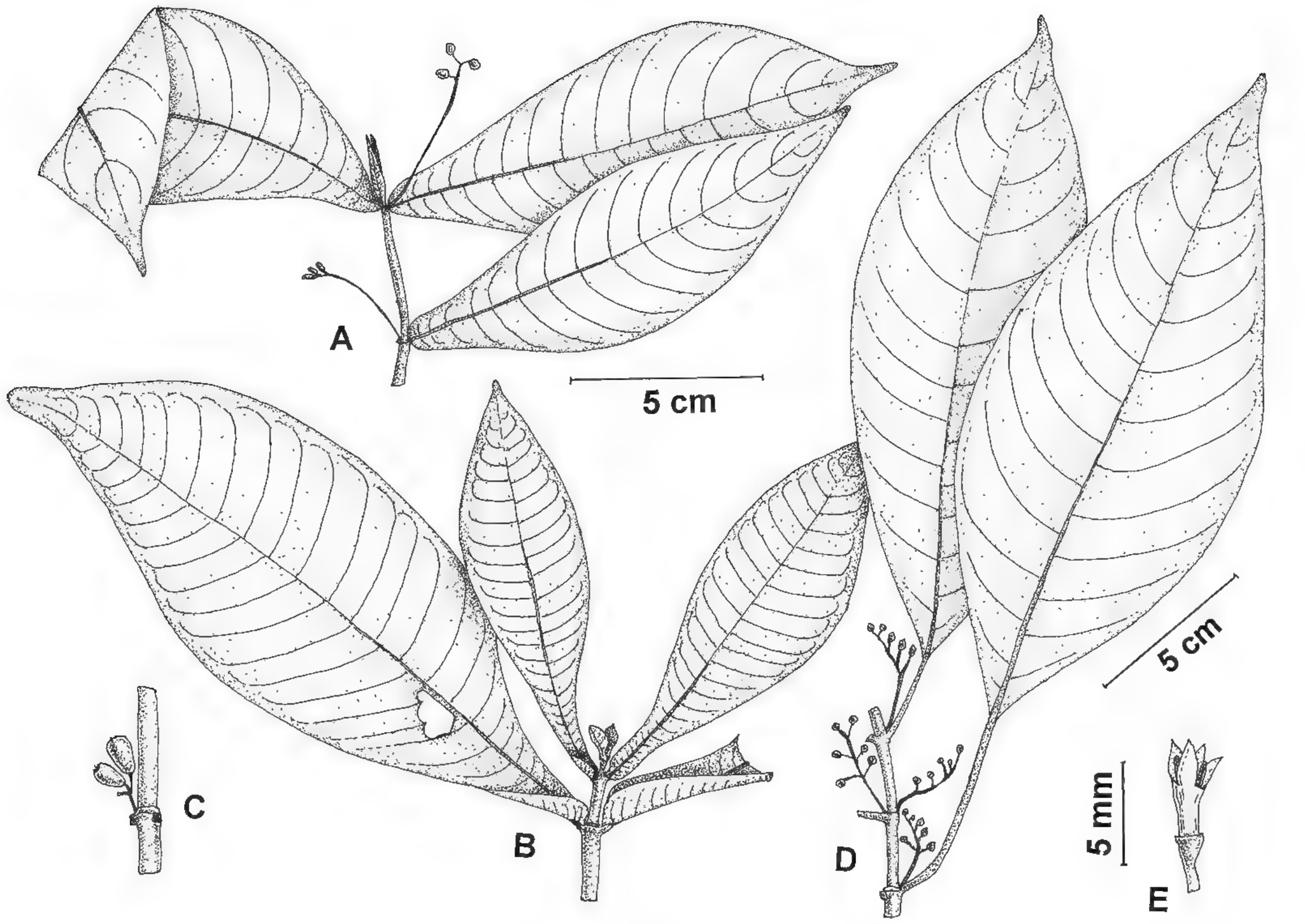

Figure 4. —A. *Hoffmannia pacifica* C. M. Taylor, portion of stem with young fruits; based on the paratype *Croat & Hannon 79131* (MO). B, C. *H. turrialbana* C. M. Taylor; based on the paratype *Téllez et al. 5309* (MO). —B. Apical portion of stem. —C. Portion of stem below leaves, with infructescence. D, E. *H. micrantha* C. M. Taylor. —D. Portion of fruiting stem; based on the paratype *Herrera 4104* (MO). —E. Flower; based on the paratype *Will 16/08/99/106* (MO). A, B, C drawn to same scale, indicated as 5 cm.

nerable due to limited geographic distribution and habitat decline (VU B1ab[iii]+2ab[iii]).

Discussion. This new species can be recognized by its well-developed petioles; its rather large leaf blades with developed but undulating submarginal veins; its short succulent stipules; its short scorpioid-racemiform or cincinnate inflorescences often borne along the stems below the leaves; its very small, dully colored corollas with the lobes at least slightly longer than the tube; and its apparently small fruits. The specific epithet refers to its small flowers. The flowers on the specimens studied are all immature or not adequate to dissect; the fruits seen and measured all appear to be immature also.

Hoffmannia micrantha is similar in particular in its inflorescences and small, dully colored flowers to *H. hammelii* C. M. Taylor, which is known from the same general region; however, *H. hammelii* can be recognized by its mostly shorter petioles (0.5–2.5 cm long), its mostly smaller leaf blades (7–18 × 4–7 cm) with the tertiary and often the quaternary venation more evident, and its corollas that are usually paler in color, i.e., white, greenish white, greenish yellow, or cream.

Paratypes. COSTA RICA. **Puntarenas:** La Gamba, Parque Nac. Esquinas, *S. Will 16/08/99/106* (MO); Sendero Catarata near Rainforest Lodge, *A. Weissenhofer W55–15.6.1997* (INB, WU); cantón Golfito, Parque Nac. Corcovado, Cerro Rincón, Dos Brazos de Río Tigre, *G. Herrera 4104* (CR, INB, MO); Jiménez, cuenca superior del Río Madrigal, *G. Herrera 4692* (CR, INB, MO); Est. Agujas, *E. Mora, D. Rubí, E. Fletes & J. Azofeifa 645* (INB), *E. Mora, D. Rubí, E. Fletes & J. Azofeifa 736* (INB, MO); Parque Nac. Piedras Blancas, Finca Don Avillan, betw. La Gamba & Golfito, *A. Huber & A. Weissenhofer 2198* (CR); cantón Osa, Fila Costeña, Río Piedras Blancas, 2 km al N, alrededores del Cerro Anguciana, *R. Aguilar, M. Segura & F. Quesada 2052* (INB, MO); along new rd. Piedras Blancas to Rincón de Osa, *M. Grayum 3418* (CR, MO); Reserva Forestal de Golfo Dulce, Rancho Quemado, ca. 15 km W of Rincón, *B. Hammel, G. Herrera, M. M. Chavarría & A. Solís 16971* (CR, DUKE, INB, MO), *M. Nepokroeff & B. Hammel 739* (CR), *F. Quesada 178* (INB, MO), *J. Solomon 19275* (CR, INB, MO); Finca Gilberto Padilla, *A. L. Marín 76* (INB, MO); sector Sureste, *J. Marín & D. Marín 524* (CR, INB, MO); cantón Puntarenas, La Pitahaya, Rincón, margen izquierda río Aranjuez, *G. Herrera 9063* (CR). **San José:** Los Llanos de Santa María, Filas Las Rejas, *O. Valverde, L. Gutiérrez & A. Estrada 114* (CR).

8. Hoffmannia pacifica C. M. Taylor, sp. nov. TYPE: Costa Rica. San José: cantón de Tarrazú, Los Llanos de Santa María, 9°32′N, 84°01′W, 800 m, 9 July 1997, *A. Estrada, O. Valverde, L. Gutiérrez & H. Gómez 967* (holotype, CR). Figure 4A.

Haec species a *Hoffmannia hammelii* C. M. Taylor foliis subsessilibus ad basim rotundatis usque truncatis cordulatisve distinguitur.

Herbs, subshrubs, or shrubs to 2 m tall, unbranched or little-branched; stems densely villosulous-hirtellous to glabrescent. *Leaves* opposite, sessile or with *petiole* to 3 mm, hirtellous to glabrescent; *blade* oblanceolate and often falcate, 5.5–14 × 2–5.5 cm, glabrous, drying papery to stiffly papery, base narrowed then abruptly rounded to truncate or cordulate, apex acute or weakly acuminate; secondary veins 7 to 11 pairs, looping to interconnect in an undulating submarginal vein, with tertiary and quaternary venation often well marked abaxially; *stipules* triangular, ca. 4 mm, flattened or perhaps fleshy, deciduous leaving a persistent fleshy truncate base 0.5–2 mm. *Inflorescences* produced with leaves, racemiform, 2.5–6.5 cm, puberulous to glabrous, 3- to 8-flowered; peduncles 1 to 2 per axil, 1.5–5 cm, slender; bracts reduced; pedicels 2–5 mm. *Flowers* pedicellate; ovary portion ellipsoid, 1.5–1.8 mm, glabrous; *calyx* limb 1.5–2 mm, glabrous, lobed for ca. 1/2, lobes narrowly triangular; *corolla* fuchsia or greenish red, salverform, externally glabrous, tube in bud to 3 mm, lobes in bud ovate, to 2.5 mm, shortly acuminate; anthers in bud ca. 2 mm; stigma not seen. *Fruits* subglobose, ca. 5 mm diam., red, with persistent calyx limb 1–1.5 mm, lobed for 1/4–2/3, lobes broadly triangular.

Habitat, distribution, and phenology. Hoffmannia pacifica is known from wet forests at 0–1400 m on the Pacific slopes of Costa Rica; it has been collected in flower in July, September, and October and in fruit in January, July, and from August through October.

IUCN Red List category. Hoffmannia pacifica meets the criterion for Endangered based on its limited EOO, small AOO, and not more than five locations (i.e., different threat regimes). It is not known from any legally protected area, and is apparently found only in a relatively small region of southern Costa Rica; some other species are known with a similar distribution so this is probably an accurate outline of its range. The habitats of this region are no doubt in decline now or in the near future due to development, and this species does not appear to be found in secondary vegetation. Therefore, this species is considered Endangered due to limited geographic range and habitat threat (EN B1ab[iii]+2ab[iii]).

Discussion. This new species can be recognized by the combination of its subsessile, rather small (for *Hoffmannia*), often somewhat asymmetric leaves that are rounded to cordulate at the base and have the secondary veins united into a looping submarginal vein, and its few-flowered, generally racemiform inflorescences. This new species is known only from the Pacific slopes of central-southern Costa Rica; the specific epithet refers to this distribution.

Hoffmannia pacifica is similar to *H. inamoena* Standl. and *H. hammelii*, both also found in Costa Rica. These species are similar particularly in their leaves with the secondary veins fused into a submarginal vein and the higher-order venation thickened and visible inside the areoles of the tertiary venation. However, *H. inamoena* and *H. hammelii* can be recognized by their leaf blades that are acute to obtuse at the base and borne on well-developed petioles. *Hoffmannia pacifica* is also generally similar to *H. stephaniae* L. A. González & Poveda, which is also found in the same general region on the Pacific slopes of Costa Rica; however, *H. stephaniae* can be separated by its very narrow leaves (0.5–1.5 cm wide) with more numerous secondary veins (17 to 21 pairs) (González & Poveda, 2004).

Paratypes. COSTA RICA. **Puntarenas:** wooded slopes above Golfito, *W. Burger & G. Matta U. [i.e., G. Mata U.] 4785* (CR, F, MO). **San José:** cantón Acosta, Sabanilla, Cerro El Cornelio, *J. Sánchez, A. Ruíz & R. Chacón 1155* (CR); cantón Pérez Zeledón, along rd. betw. San Isidro [del] General & Dominical, Fila Tinamastes, *T. Croat & D. Hannon 79131* (MO); Finca La Laguna, Los Angeles, *O. Valverde, A. Estrada & H. Gómez 247* (CR); cantón Tarrazú, cuenca del Naranjo & Paquita, San Carlos, Bajo La Virgen, Finca Ríos Paraíso, camino a cerros de Quepos, *A. Rodríguez, J. González, A. Estrada & A. Quesada 8113* (INB); Faja Costeña del Valle del Parrita entre Nápoles & Santa Marta, *O. Vargas 462* (INB, MO); San Marcos de Tarrazú, estribación del cerro al SE pueblo Naranjito, contiguo al Río Naranjo, *A. Cascante, G. Herrera & J. Sánchez 905* (CR); Tinamaste, Finca de los Suizos, *A. Estrada, D. Arguello, E. Volio & H. Binder 872* (CR); cantón Turrubares, Zona Parque Cerro de Turrubares, cuenca del Tarcoles, San Luis, faldas del Cerro Pelón, *A. Rodríguez, A. Estrada, R. Chacón, D. Solano & A. Soto 9345* (INB).

9. Hoffmannia pseudovesiculifera C. M. Taylor, sp. nov. TYPE: Panama. Bocas del Toro: detrás del camp. Corriente Grande, Changuinola IRHE, 22 Feb. 1980, *M. D. Correa A., A. Taylor, N. Salazar, R. Mendoza, T. Beliz, C. Vergara & D. Vergara 3542* (holotype, PMA; isotype, MO-3741460). Figure 3C–E.

Haec species a *Hoffmannia vesiculifera* Standl. inflorescentia cincinnoideo-scorpioidea atque corollae lobis longioribus tubum excedentibus distinguitur.

Herbs or subshrubs to 1.2 m tall, perhaps little-branched; stems densely villous or hirsute-tomentose. *Leaves* opposite, subsessile or with *petiole* to 20 mm, densely villous or villous-tomentose; *blade* obovate, 13–27 × 6–13.5 cm, adaxially villous with trichomes distributed across lamina, abaxially villous to villosulous with trichomes mostly borne on veins, drying papery, base cuneate to acute and prolonged then with a pair of narrowly ellipsoid vesicles 1–3 × 0.3–0.6 mm, apex obtuse then usually abruptly shortly acuminate; secondary veins 11 to 16 pairs, free, reticulating with margins, or sometimes a few pairs weakly looping to interconnect near margins, tertiary venation well developed; *stipules* triangular to narrowly triangular, 4–6 mm, densely villous, deciduous. *Inflorescences* produced generally with leaves, cincinnate to scorpioid sometimes becoming racemiform with age, often bifurcate from peduncle, 3–7 cm, densely villous, many-flowered; peduncles 1 to 2 per axil, 0.5–1 cm; bracts reduced; pedicels 2–3 mm. *Flowers* pedicellate; ovary portion narrowly ellipsoid or narrowly obconic, ca. 3 mm, densely villous; *calyx* limb lobed nearly to base, moderately to densely villous, lobes narrowly triangular to linear, 7–10 mm; *corolla* yellow to orange, rotate, externally villous to glabrescent, tube 8–11 mm, lobes lanceolate, 14–20 mm, acuminate; anthers 2–3 mm; stigmas ovate, ca. 1 mm. *Fruits* not seen.

Habitat, distribution, and phenology. Hoffmannia pseudovesiculifera is known from wet forest at ca. 300 m on the Caribbean slopes of western Panama; it has been collected in flower in December, January, and February.

IUCN Red List category. Hoffmannia pseudovesiculifera meets the geographic range criterion for Endangered based on its small AOO and not more than five locations (i.e., different threat regimes); because there are only two collection localities, the EOO cannot be calculated. This species is found in one legally protected area, which may not have significant continuing habitat decline at the moment, but is likely to have decline in the future due to local development. However, this area is not well explored botanically so this species may be more common and widespread than is evident from these specimens. This species is considered Vulnerable due to its limited number of locations and probable threats (VU D2), although if this species were in fact locally rare and the habitat declining rapidly, then it would be considered Endangered.

Discussion. This new species can be recognized by its low habit; villose or hirsute-tomentose pubescence; shortly pedunculate inflorescences generally with two cincinnate, scorpioid, or racemiform portions without foliaceous bracts; and relatively large corollas with the lobes longer than the tube. The specific epithet refers to the similarity and previous confusion of this new species with *Hoffmannia vesiculifera*. *Hoffmannia pseudovesiculifera* is so far known only from the lower slopes of Bocas del Toro in western Panama, but this region is poorly known, and this species may not be uncommon and may also grow in southeastern Costa Rica.

Hoffmannia pseudovesiculifera is similar to *H. vesiculifera*, but *H. vesiculifera* can be recognized by its pedunculate, corymbiform, dichasially branched inflorescences enclosed by one to three pairs of foliaceous bracts and its corollas with shorter lobes (6–10 mm long) that are half as long as the tube.

Paratypes. PANAMA. **Bocas del Toro:** 15 km up Changuinola River to IRHE dam site No. 1, *T. Antonio 3083* (MO); al NO del Camp. Changuinola 1 de Corriente Grande, Cerro Bracha, *M. Correa A., A. Taylor, R. Mendoza, N. Salazar, T. Beliz & C. Vergara 3179* (MO, PMA).

10. Hoffmannia rivalis C. M. Taylor, sp. nov. TYPE: Peru. Amazonas: prov. Condorcanqui, dist. El Cenepa, comun. San Antonio, Río Cenepa, bosque de ribera, 4°30′S, 78°11′W, 300 m, 16 June 1997, *R. Vásquez, A. Peña, E. Chávez & E. Quiaco 24071* (holotype, USM; isotype, MO-04898272). Figure 2C, D.

Haec species a congeneris habitu gracili, caulis pubescentia densa brevique, foliis angustis, floribus parvis atque fructu angusto distinguitur; etiam locos riparios inundatos habitat.

Herbs or subshrubs to 0.5 m tall, slender, branched; stems densely strigillose-tomentulose. *Leaves* opposite; *petiole* 3–10 mm, densely strigillose-tomentulose to glabrescent; *blade* narrowly elliptic to narrowly oblanceolate, 5–17 × 1.5–4 cm, adaxially glabrous, abaxially strigillose-puberulous along veins and glabrescent on lamina, drying chartaceous to stiffly papery, base acute to attenuate, apex acute to acuminate; secondary veins 4 to 8 pairs, not or rarely looping weakly to interconnect near margins, tertiary venation developed; *stipules* narrowly triangular, 1–3 mm, densely strigillose-puberulous, acute, deciduous. *Inflorescences* produced with leaves and along stems below leaves, cymose and often regularly dichasial, 1.5–3 cm, strigillose or hirtellous to glabrescent, 3- to 11-flowered; peduncles 1 to 2 per axil, 0.8–1.5 cm; bracts reduced; pedicels 1–6 mm. *Flowers* pedicellate; ovary portion narrowly

ellipsoid to narrowly obconic, 1.2–2 mm, strigillose; *calyx* limb lobed nearly to base, strigillose to glabrescent, lobes narrowly triangular, 0.5–1.2 mm, acute, apparently enlarging as fruit develops; *corolla* yellow to red, salverform to rotate, externally glabrous, tube ca. 2 mm, lobes narrowly triangular to narrowly ligulate, 2.2–4 mm, acute; anthers 2–3 mm; stigmas clavate, ca. 1 mm. *Fruits* narrowly ellipsoid, ca. 8 mm, red.

Habitat, distribution, and phenology. *Hoffmannia rivalis* is known from woody vegetation along rivers in wet forests at 300–900 m, in the Río Cenepa region of southern Ecuador and northern Peru; it has been collected in flower June through August and in fruit concurrently in June.

IUCN Red List category. *Hoffmannia rivalis* meets the geographic range criterion for Endangered based on its limited EOO, small AOO, and not more than five locations (i.e., different threat regimes). It is found in one legally protected area and appears to be endemic to a relatively small region near the border of Ecuador and Peru. However, this region is not well known botanically, and the microhabitat of *H. rivalis* is inundated riversides, so this species may be more common and widely distributed than documented by collections. Whether its microhabitat is in significant decline is unknown, but presumably in some areas this habitat is adequately preserved. Therefore, this species is considered Vulnerable due to its limited number of locations (VU D2).

Discussion. This new species can be recognized by its slender habit, rather narrow elongated leaves and fruits, dense short stem pubescence, small flowers, and narrowly elliptic immature fruits, as well as apparently its riverside habitat. This is the first report of the rheophytic habit in *Hoffmannia*, and the specific epithet refers to this. Few other *Hoffmannia* species are found at these relatively low elevations in the Río Cenepa region of southern Ecuador and adjacent Peru; *H. rivalis* differs from all of the species known from this region in its smaller corollas.

Paratypes. ECUADOR. **Zamora-Chinchipe:** cantón Nangaritza, Miazi, Río Nangaritza valley, above military post, *A. Gentry 80977* (MO). PERU. **Amazonas:** prov. Condorcanqui, dist. El Cenepa, comun. Mamayaque, Río Cenepa, *R. Rojas, A. Peña & E. Chávez 21* (MO).

11. Hoffmannia subcapitata C. M. Taylor, sp. nov. TYPE: Costa Rica. Limón: Matina, Parque Nac. Barbilla, cuenca del Matina, sendero Las Pitas, Quebrada El Dulce, 9°59′N, 83°24′W, 600–700 m, 10 Apr. 2000, *E. Mora 1020* (holotype, INB; isotypes, CR, MO-6271353). Figure 5A, B.

Haec species a *Hoffmannia kirkbridei* Dwyer petiolo breviore, inflorescentia subcapitata pedunculata atque lobis calycinis longioribus latioribus distinguitur.

Robust herbs or subshrubs to 2 m tall, perhaps little-branched; stems hirtellous-tomentulose to glabrescent. *Leaves* opposite; petiole (i.e., below vesicles) 10–15 mm; *blade* elliptic, 21–32 × 11–18.5 cm, adaxially glabrous, abaxially hirtellous to hispidulous at least along principal veins, drying papery, base cuneate to attenuate then with a pair of narrowly ellipsoid vesicles 2–2.5 × ca. 0.5 cm, apex acuminate; secondary veins 9 to 10 pairs, free or looping to connect and/or reticulated into an undulate submarginal vein, tertiary venation rather well developed; *stipules* narrowly ligulate, 9–12 mm, fleshy, shortly 2-lobed, lobes 1.5–2 mm. *Inflorescences* produced with leaves, subcapitate or densely congested-cymose, densely villosulous or tomentulose-hirtellous, many-flowered; peduncles 1 to 3 per axil, 1–3 cm; heads or cymes subglobose, 0.5–1.5 cm diam.; bracts ligulate, 2–4 × 1.2–2 mm; pedicels 0.5–2.5 mm. *Flowers* pedicellate; ovary portion obconic, ca. 2 mm, villosulous; *calyx* limb divided essentially to base, lobes ligulate, 4–5 × 1.2–2 mm, villosulous to glabrescent, obtuse or rounded, densely ciliolate; *corolla* yellow, rotate, externally glabrescent on tube and densely hirtellous or villosulous on middle or full surface of lobes, tube 2–3 mm, lobes narrowly triangular, 5.5–6 mm, acute; anthers exserted, ca. 4 mm; stigmas ovate, ca. 0.8 mm. *Infructescences* with axes elongating, becoming congested-cymose, to 3 cm wide. *Fruits* ellipsoid, 3–5 × 2–3.5 mm, laterally somewhat flattened, glabrescent, mature color unknown.

Habitat, distribution, and phenology. *Hoffmannia subcapitata* is known from wet forests at 600–1700 m on the Caribbean slopes of northern and central Costa Rica; it has been collected in flower in April and in fruit in August, October, and November.

IUCN Red List category. *Hoffmannia subcapitata* meets the geographic range criterion for Endangered based on its limited EOO, its small AOO, and not more than five locations (i.e., different threat regimes). It is found in two legally protected areas. *Hoffmannia subcapitata* seems to be restricted to a relatively narrow elevational band and habitat. Two of its known locations are apparently protected, but the third may be susceptible to habitat decline. This species is considered Vulnerable due to its limited range (VU D2), but if any part of its habitat were to

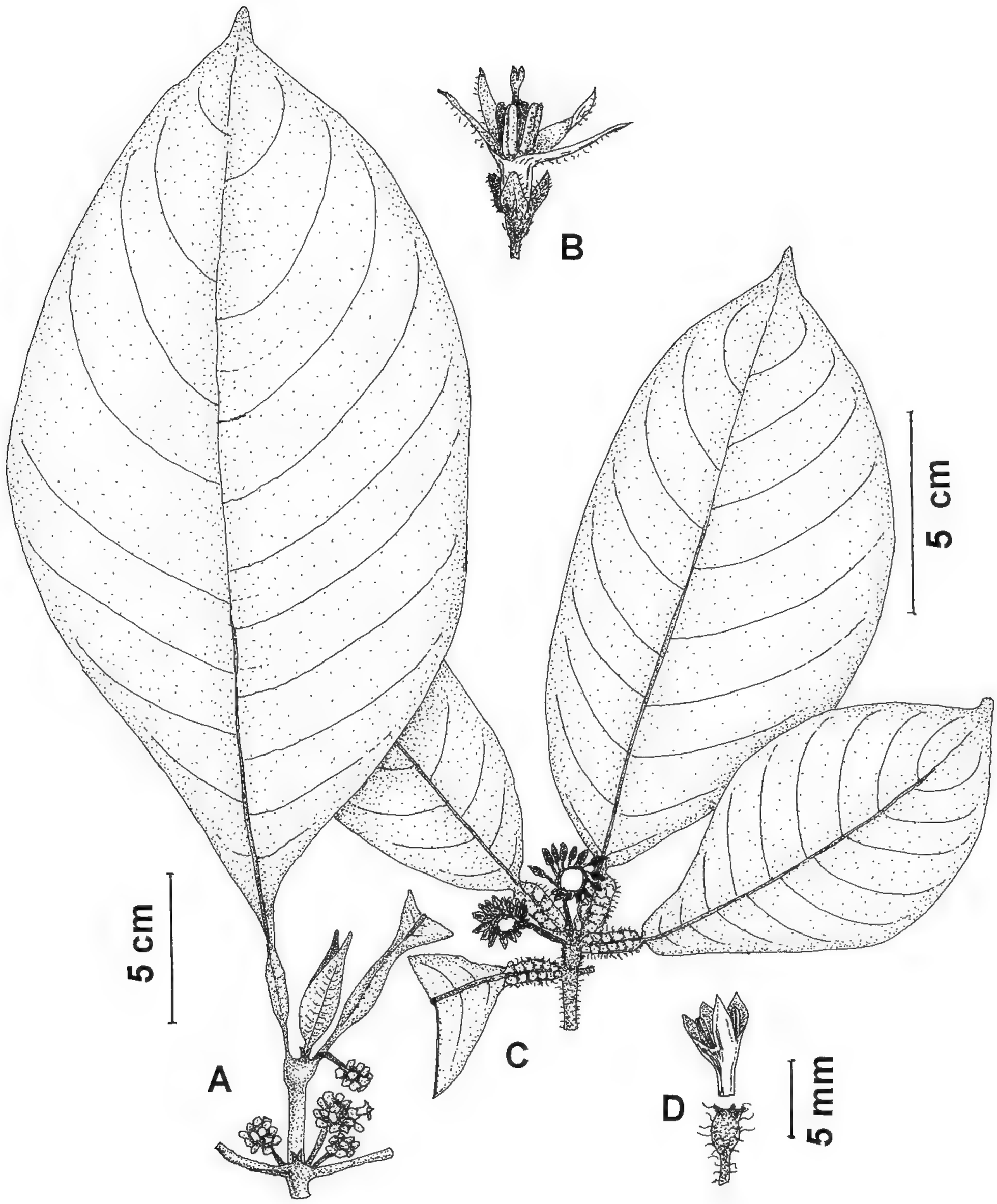

Figure 5. Some vesiculate species of *Hoffmannia*. A, B. *H. subcapitata* C. M. Taylor; based on the type *Mora 1020* (MO). —A. Apical portion of stem with inflorescence. —B. Flower. C, D. *H. veraguensis* C. M. Taylor. —C. Apical portion of stem with inflorescences; based on the paratype *Hammel 4654* (MO). —D. Flower, partially dissected; based on the type *Dressler 4790* (MO). B, D drawn to same scale, indicated as 5 mm.

decline markedly it would quickly become Endangered.

Discussion. This new species can be recognized by its relatively large leaf blades each with a pair of slender vesicles at the tapered base; its short petioles; its well-developed, shortly bilobed stipules; its shortly pedunculate inflorescences with the flowers arranged in dense subglobose groups; its well-developed ligulate calyx lobes; and its yellow corollas that are pubescent externally at least on the lobes and that have the lobes longer than the tube. The subglobose inflorescences or flower groups are unusual in *Hoffmannia*, and the specific epithet refers to this feature. The inflorescences become more lax as the fruits develop and the axes and pedicels become somewhat more prolonged and spreading.

Hoffmannia subcapitata is similar to *H. kirkbridei* of Panama, in particular in leaf size and shape and the well-developed, rather broad calyx lobes; *H. kirkbridei* is known from only two rather poor specimens that lack corollas and stipules, but can be separated from this new species by its well-developed petioles (4–11 cm long), its larger vesicles (3–7 cm long), and its cymose inflorescences that are shortly branched to one to two orders even before the fruits develop.

Paratypes. COSTA RICA. **Alajuela:** cantón San Carlos, Parque Nac. Juan Castro Blanco, cuenca del San Carlos, entrando por San Vicente, faldas del Cerro Platanar, *A. Rodríguez, V. Ramírez & G. Sancho 6141* (INB). **Limón:** cantón Limón, Zone Parque Río Banano, Valle de La Estrella, Fila Matama, ca. 11 km SW of pueblo Aguas Zarcas, *D. Solano, A. Rodríguez, B. Gamboa R., D. Santamaría, E. Boza, M. Hernández Peña, M. Moraga, O. Chacón Chavarría & R. Delgado Dávila 4898* (BM, INB), *A. Rodríguez, A. Monro, D. Santamaría, D. Solano, B. Gamboa R., E. Bosa & M. Hernández Peña, M. Moraga, O. Chacón Chavarría & R. Delgado Dávila 11457* (INB); alrededores del camp., *D. Santamaría 6567* (BM, INB).

12. Hoffmannia tilaranensis C. M. Taylor, sp. nov. TYPE: Costa Rica. Alajuela: San Carlos, San Miguel de San Isidro, 600 m, 29 June 1985, *W. A. Haber & E. Bello C. 1685* (holotype, CR; isotype, MO-05005230). Figure 1A, B.

Haec species a *Hoffmannia nicotianifolia* (M. Martens & Galeotti) L. O. Williams foliis majoribus, pedunculo breviore, corolla viridi colore purpureo atrorubrove suffusa vittatave atque tubo corollino longiore distinguitur.

Subshrubs and shrubs to 2 m tall, little-branched; stems glabrous. *Leaves* opposite; *petiole* 10–20 mm, glabrous; *blade* obovate to elliptic-obovate, 10–32 × 5–12 cm, glabrous, drying papery, base acute to attenuate, apex acuminate with tips to 2 cm; secondary veins 8 to 11 pairs, weakly uniting in a looping submarginal vein, tertiary venation not or hardly visible; *stipules* pyramidal, 1.5–3 mm, succulent, glabrous, glandular, deciduous. *Inflorescences* produced with leaves and sometimes along stems at several nodes below leaves, dichasially cymose to congested-cymose, 1.5–3 cm, puberulous to strigillose, 3- to 9-flowered; peduncles 1 to 3 per axil, 3–8 mm; bracts reduced; pedicels 2–4 mm. *Flowers* pedicellate, deflexed to pendulous; ovary ellipsoid-obconic, ca. 2 mm, puberulous-strigillose; *calyx* limb 1.2–2 mm, puberulous-strigillose, lobed for 3/4 to nearly to base, lobes ligulate to triangular; *corolla* green usually flushed or striped with purple or dark red, rotate, externally puberulous, tube in bud to 4 mm, lobes in bud to 5 mm, narrowly triangular, acute; mature anthers and stigmas not seen. Immature *fruits* narrowly ellipsoid, to 4.5 × 2 mm, color unknown.

Habitat, distribution, and phenology. *Hoffmannia tilaranensis* is known from wet lowland and premontane forest at 400–1600 m in northern Costa Rica; it has been collected in flower in May and June.

IUCN Red List category. *Hoffmannia tilaranensis* meets the criterion for Endangered based on its limited EOO, its small AOO, and not more than five locations (i.e, different threat regimes). It is not found in any legally protected area. *Hoffmannia tilaranensis* is found across a rather wide elevational range, but does not appear to be common anywhere. The habitat in the areas where this species has been found is certainly in decline, although some samples of this type of habitat are preserved in this region. All of the collections studied of this species were made about 25 years ago (1984–1986), so this species has apparently not been found recently. Therefore, this species is considered Endangered due to limited geographic range and habitat destruction (EN B1ab[iii]+2ab[iii]).

Discussion. *Hoffmannia tilaranensis* can be recognized by the combination of its glabrous stems and leaves, its rather large leaf blades that are broadest above the middle, its short cymose inflorescences with the flowers and also largest flower buds markedly drooping, and its corollas that are generally flushed or striped with purple or dark red and have the lobes longer than the tube. This new species is known from the mountains of northern Costa Rica, in particular the Cordillera de Tilarán; the specific epithet refers to this distribution.

Hoffmannia tilaranensis is similar to *H. nicotianifolia* (M. Martens & Galeotti) L. O. Williams, which is found in the same region; however, *H. nicotianifolia* can be separated here by its generally smaller leaves (1.5–6 cm wide), its usually longer peduncles (6–15 mm long), its shorter calyx lobes (0.3–1 mm long), its white to pale yellow or pale green corollas with the tube shorter (1.5–2 mm long), and its subglobose fruits.

Paratypes. COSTA RICA. **Alajuela:** Arenal Volcano, along trail from observatory to summit of Cerro Chato, *V. A. Funk, B. Umaña, F. O. Smith & others [sic on label] 10710* (MO); Reserva Forestal de San Ramón, ca. 10 km W of Lagitos, along Río San Lorencito, *B. Hammel, G. de Nevers & C. Gómez 15298* (CR, MO); N of San Ramón, Km 15 35 rd. La Tigra & Fortuna, *C. M. Taylor & C. Tingley 4320* (DUKE). **Guanacaste–Puntarenas border:** ca. 6.5 km from Santa Elena along rd. to Tilarán past Finca Hira Rosa, *C. M. Taylor 3026* (DUKE, MO).

13. Hoffmannia turrialbana C. M. Taylor, sp. nov. TYPE: Costa Rica. Cartago: 13 km E of Turrialba on hwy. to Limón, canyon of Río

Chitaría, 750–800 m, 9°55′N, 83°36 W, 10 May 1983, *R. Liesner, E. Judziewicz & B. Pérez G. 15410* (holotype, CR; isotype, MO-05005248). Figure 4B, C.

Haec species a *Hoffmannia pittieri* Standl. foliis subsessilibus ad basim truncatis usque cordulatis nervis secundariis numerosioribus, inflorescentia racemiformi pauciflora atque fructu in sicco anguste ellipsoideo distinguitur.

Subshrubs or shrubs to 2 m tall, apparently little-branched or unbranched; stems glabrous. *Leaves* opposite, sessile or subsessile; *blade* obovate or oblanceolate, 13–39 × 4.5–12 cm, glabrous, perhaps pale abaxially, drying papery, base narrowed then abruptly truncate to cordulate, apex acute; secondary veins 17 to 20 pairs, mostly united in a well-developed submarginal vein, tertiary veins not or hardly visible; *stipules* triangular to pyramidal, 2–3 mm, succulent, acute, deciduous. *Inflorescences* borne in axils of lowermost leaves or along stems below leaves, shortly umbelliform-cymose or racemiform, 1.5–3 cm, glabrous, 2- to 5-flowered; peduncles 1 to 2 per axil, 0.5–1.5 cm; bracts reduced; pedicels 4–6 mm. *Flowers* pedicellate; ovary portion ellipsoid, ca. 2.5 mm, glabrous; *calyx* limb ca. 1 mm, glabrous, lobed shallowly or for up to 1/2, lobes broadly triangular; *corolla* yellow or orange, funnelform, externally glabrous, tube ca. 8 mm, lobes triangular, ca. 4 mm, acute; stamens and stigma not seen. *Fruits* narrowly ellipsoid, 8–9 × 4–5 mm, red.

Habitat, distribution, and phenology. *Hoffmannia turrialbana* is known from premontane forests at 750–1400 m on the Caribbean slopes of central Costa Rica; it has been collected in flower in May and July and in fruit in February and June.

IUCN Red List category. *Hoffmannia turrialbana* meets the geographic range criterion for Critically Endangered based on its limited EOO and its limited AOO, but only qualifies as Endangered due to its more than one but not more than five locations (i.e., different threat regimes). *Hoffmannia turrialbana* is known from one legally protected area, and is apparently restricted to a relatively narrow elevational zone. One or more of its known locations are certainly in habitat decline. Therefore this species is considered Endangered due to limited geographic range and habitat decline (EN B1ab[iii]+2ab[iii]).

Discussion. *Hoffmannia turrialbana* can be recognized by the combination of its obovate or oblanceolate leaves that are subsessile, abruptly truncate to cordulate at the base, and with the tertiary venation that is not or sparsely visible; its few-flowered inflorescences; its corollas with the tube significantly longer than the lobes; and its narrow, rather elongated fruits. This new species is so far only known from the region of Turrialba; the specific epithet refers to this locality.

Hoffmannia turrialbana is similar in general aspect to *H. amplexifolia* Standl. and *H. subauriculata*, which are both also found in the same general region on the Caribbean slopes of central Costa Rica; however, those two previously described species can be separated by their leaves with nine to 13 pairs of secondary veins and their corollas with the lobes significantly longer than the tube. This new species is also similar to *H. pittieri* Standl., which is also known from this same general region on the Caribbean slopes of central Costa Rica and has similar corollas; however, *H. pittieri* can be separated by its well-developed petioles, its leaves that are obtuse to acute at the base and have nine to 13 pairs of secondary veins, its inflorescences with usually more than five flowers, and its ovaries and fruits that are broadly ellipsoid to subglobose in shape.

Paratypes. COSTA RICA. **Cartago:** along Camino Raiz de Hule, SE of Platanillo (Tsipiri), *T. Croat 36815* (MO); 16 km SE of Turrialba, camino a Puerto Limón, *O. Téllez, H. Brailowski & E. Barrera 5309* (MEXU, MO); a la entrada de Chataría, carr. entre Turrialba & Siquirres, *J. Gómez-Laurito 6775* (CR).

14. Hoffmannia veraguensis C. M. Taylor, sp. nov. TYPE: Panama. Veraguas: Guabal (Río Dos Bocas) ca. 16 km NW of Santa Fé, ca. 500 m, 15–16 Nov. 1972, *R. L. Dressler 4790* (holotype, MO-2288680). Figure 5C, D.

Haec species a *Hoffmannia formicaria* C. M. Taylor lobis calycinis brevioribus glabrescentibus atque corolla minore distinguitur.

Herbs or subshrubs to 0.6(–1) m tall, unbranched, often weak and extensively rooting near base; stems densely villous or hirsute-tomentose. *Leaves* opposite; *petiole* (i.e., below vesicles) 3–10 mm; *blade* elliptic, obovate, or obovate-oblong, 8–20 × 5–10 cm, adaxially moderately to rather densely hispid or hirsute, abaxially hispidulous to hirtellous or hirsute with pubescence denser along veins, drying papery, base cuneate to rounded then with a pair of narrowly ellipsoid or ellipsoid-oblong vesicles 1–2.2 × 0.5–1 cm, apex rather abruptly and shortly acuminate; secondary veins 8 to 12 pairs, free or with a few pairs weakly looping to interconnect, tertiary venation well developed; *stipules* narrowly triangular to narrowly ligulate, 3–5 mm, succulent, densely hirsute, obtuse to acute or apparently shortly 2-dentate, deciduous. *Inflorescences* produced with leaves, cincinnate to

helicoid, 2.5–7.5 cm, densely hirsute or villous, 5- to 30-flowered; peduncles 1 per axil, 1–4 cm; bracts reduced; pedicels 1–5 mm. *Flowers* pedicellate; ovary slenderly ellipsoid, ca. 2 mm, hirsute; *calyx* limb lobed nearly to base, lobes narrowly triangular to linear, 1.2–4 mm, hirsute; *corolla* white or cream sometimes flushed and/or striped with brown, brownish red, or green, rotate, externally glabrescent to sparsely hirsute at least in apical portion, tube 3–4 mm, lobes narrowly triangular, 3.5–5 mm, acute to obtuse; anthers ca. 3 mm; stigmas not seen. *Fruits* subglobose, ca. 6 mm diam., red.

Habitat, distribution, and phenology. *Hoffmannia veraguensis* is known from wet and premontane forests at 500–1000 m on the Pacific slopes of west-central Panama; it has been collected in flower July through September and in November and in fruit November through January.

IUCN Red List category. *Hoffmannia veraguensis* meets the geographic range criterion for Endangered based on its limited EOO, its limited AOO, and its no more than five locations. This species is found in two legally protected areas, and overall is known from a small geographic region. Some of its locations may be reasonably well preserved and protected, but the threat to its habitat is widespread and relatively uniform at least outside the protected areas. This species is considered Endangered due to limited geographic range and habitat decline (EN B1ab[iii]+2ab[iii]).

Discussion. *Hoffmannia veraguensis* can be recognized by its low habit, villous or hirsute-tomentose pubescence, shortly petiolate leaves of moderate size with paired vesicles at the base, well-developed calyx lobes, and corollas with the lobes slightly longer than the lobes. This new species is similar to *H. formicaria* and appears to replace that species in west-central Panama; the specific epithet refers to its range, which is best documented in Veraguas.

This new species is quite similar to *Hoffmannia formicaria*, which is described previously in this article; but *H. veraguensis* can be recognized by its shorter calyx lobes, usually more slender and prolonged inflorescences, and mostly smaller corollas.

Paratypes. PANAMA. **Coclé:** N of El Copé, Río Corazón, Caribbean slope, W of main trail to Limón, *R. Dressler 5990* (MO). **Veraguas:** vic. of Escuela Agricultura Alto Piedras near Santa Fé, along trail to top of Cerro Tute, *T. Antonio 2926* (MO); valley of Río Dos Bocas on rd. to Calovebora, *T. Croat 27502* (MO); on slopes of Cerro Tute, Parque Nac. Cerro Tute, *T. Croat & G. Zhu 76903* (MO), *S. Mori, A. Bolten & R. Dressler 7534* (MO); mtns. W of Siclo Básico school, *B. Hammel 4654* (MO); slopes & peak of Cerro Arizona, *B. Hammel 4703* (MO); along Río Dos Bocas, *S. Mori & J. Kallunki 3144* (MO); 8.8 km from Escuela Agrícola, *S. Mori & J. Kallunki 4014* (MO); trail from Bajo Chitra to Río Gatú, Pacific slope, *G. De Nevers & G. McPherson 6768* (MO).

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Rubiacearum Americanarum Magna Hama Pars XXVII: Six New Species and a New Taxonomic View of *Posoqueria*

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Abstract. The Neotropical genus *Posoqueria* Aubl. (Rubiaceae) has a number of species with an asymmetric androecium and pollen catapult mechanism and others that apparently lack these features. A new taxonomy based on corolla form and size, the length and symmetry of the filaments, and fruit morphology finds the name *P. panamensis* (Walp. & Duchass.) Walp. to be a synonym of *P. latifolia* (Rudge) Roem. & Schult. and distinguishes additional species in southern Central America and northwestern South America, newly described here: *P. chocoana* C. M. Taylor of wet lowland Panama to northwestern Ecuador has medium-sized corollas, subglobose fruits, corolla lobes of unequal size, and a generally symmetric androecium that apparently lacks the pollen catapult mechanism; *P. correana* C. M. Taylor of lowland and premontane Panama has medium-sized corollas, leaf blades that are sharply acute at the apex and densely velutinous abaxially, slightly unequal corolla lobes, and a generally symmetric androecium that apparently lacks the pollen catapult mechanism; *P. costaricensis* C. M. Taylor, found in premontane forests in Costa Rica and Panama, has relatively short corollas (for *Posoqueria*) and a generally symmetric androecium that apparently lacks the pollen catapult mechanism; *P. grandifructa* Hammel & C. M. Taylor of lowland Nicaragua and Costa Rica has medium-sized corollas, relatively large, ellipsoid, rough-surfaced, thick-walled fruits, and a generally symmetric androecium that apparently lacks the pollen catapult mechanism; *P. longifilamentosa* C. M. Taylor of lowland northwestern Ecuador has relatively long corollas and an asymmetric androecium with a pollen catapult mechanism, relatively long unequal filaments, and relatively large anthers; and *P. robusta* Hammel & C. M. Taylor of lowland Nicaragua and Costa Rica has leathery leaves, relatively long corollas with unequal lobes, subglobose leathery fruits, and a symmetric androecium that apparently lacks the pollen catapult mechanism.

Resumen. El género neotropical *Posoqueria* Aubl. (Rubiaceae) incluye varias especies con androceo asimétrico y un mecanismo de dispersión del polen por catapulta, y varias especies sin estes carácteres. Una taxonomía nueva basada en la forma y el tamaño de la corola, el largo y la simetría de los filamentos y la morfología de los frutos demuestra que el nombre *P. panamensis* (Walp. & Duchass.) Walp. es sinónimo de *P. latifolia* (Rudge) Roem. & Schult., y distingue otras especies en el sur de América Central y el noroeste de América del Sur, nuevamente descritas aquí: *P. chocoana* C. M. Taylor de tierra baja húmeda de Panamá al noroeste de Ecuador tiene corolas de tamaño mediano, frutos subglobosos y los lobos de la corola de tamaño desigual, además un androceo por lo general simétrico que aparentemente no tiene el mecanismo de catapulta de polen; *P. correana* C. M. Taylor de tierra baja y premontana de Panamá tiene corolas de tamaño mediano, hojas con la lámina muy aguda en el ápice y densamente velútina en el envés, lobos de la corola un poco desiguales y un androceo por lo general simétrico que aparentemente no tiene el mecanismo de catapulta de polen; *P. costaricensis* C. M. Taylor, de bosques premontanos en Costa Rica y Panamá, tiene corolas relativamente cortas (para *Posoqueria*) y un androceo por lo general simétrico que aparentemente no tiene el mecanismo de

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catapulta de polen; *P. grandifructa* Hammel & C. M. Taylor de tierra baja de Nicaragua y Costa Rica tiene corolas de tamaño mediano, frutos relativamente grandes, elipsoides, de superficie tosca y de pared gruesa y un androceo por lo general simétrico que aparentemente no tiene el mecanismo de catapulta de polen; *P. longifilamentosa* C. M. Taylor de tierra baja de Ecuador tiene corolas relativamente largas, un androceo asimétrico con un mecanismo de catapulta de polen, filamentos relativamente largos y desiguales y anteras relativamente grandes; y *P. robusta* Hammel & C. M. Taylor de tierra baja de Nicaragua y Costa Rica tiene hojas coriáceas, corolas relativamente largas con los lobos desiguales, subglobosos frutos coriáceos y un androceo simétrico que aparentemente no tiene el mecanismo de catapulta de polen.

Key words: Colombia, Costa Rica, Ecuador, Henriquezieae, IUCN Red List, Ixoroideae, Nicaragua, Panama, pollination biology, *Posoqueria*, Posoquerieae, Rubiaceae.

The Neotropical genus *Posoqueria* Aubl. (Rubiaceae) includes about 25 species of shrubs and small to medium-sized trees found in wet lowland to montane vegetation and in gallery and scrub forest from Mexico through to Bolivia and southern Brazil. *Posoqueria* is notable for its white salverform corollas with very prolonged slender tubes, up to 36 cm long and generally only 2–4 mm diam. The genus is characterized by its woody habit; its ovate to elliptic stipules that are interpetiolar or sometimes very shortly united around the stem, held erect and back-to-back in bud, and usually quickly deciduous from the stems; its terminal, shortly cymose inflorescences with the bracts small or sometimes only irregularly developed; its pedicellate, homostylous, showy flowers; its notably long slender corollas with the five lobes that are imbricate in bud; its five anthers that are dorsifixed near the base on short to well-developed filaments and have a short, generally triangular sterile projection of the thecae on each end (Puff et al., 1995); its completely or occasionally incompletely 2-locular ovary with the numerous ovules borne on axile placentas; and its well-developed, baccate, often rather thick-walled fruits generally 3–13 cm long and with several broadly angled smooth seeds, generally 1–1.5 cm long, immersed in the fleshy, mealy, or gelatinous pulp. The flowers are nocturnal and fragrant, and pollinated by sphingid moths (Bawa & Beach, 1983; Beach, 1983). Delprete (2009) noted that the corolla lobes may sometimes be convolute; this was also reported by Burger and Taylor (1993), but has not been reconfirmed and may be based on incomplete observations of the imbricate arrangement. The most common and widespread species is *P. latifolia* (Rudge) Roem. & Schult., which is also occasionally cultivated as an ornamental. The relationships of *Posoqueria* have long been unclear, but recent molecular data have clarified its position in the subfamily Ixoroideae. It has been included in the tribe Posoquerieae by Delprete et al. (2004) and Delprete (2009), and in the Henriquezieae subtribe Posoqueriinae by Robbrecht and Manen (2006). Molecular data have indicated that *Posoqueria* is related to *Molopanthera* Turcz., with these two genera together sister to *Gleasonia* Standl. and *Sipanea* Aubl. (Rova et al., 2002; *Platycarpum* Bonpl. was not included in their analysis), and also that *Posoqueria* is related to *Platycarpum* and *Sipanea* (Cortés et al., 2009; *Gleasonia* and *Molopanthera* were not included in their analysis).

A notable feature of many *Posoqueria* species is the asymmetric androecium with a characteristic catapult mechanism of pollen dispersal. This mechanism has been described in detail by several authors including Hutchinson (1915), Beach (1983), and Puff et al. (1995), and was recently summarized also by Delprete (2009), who illustrated in detail the characteristic unequal stamen filaments. In these *Posoqueria* flowers, the two dorsal stamens have the longest filaments, the two lateral stamens have filaments of intermediate length, and the ventral filament is the shortest; the anthers are of similar size and variously glabrescent to puberulous, pilosulose, and/or pilose in tufts. When the corolla first opens, the introrse anthers are weakly united into an ellipsoid structure (Hutchinson, 1915: fig. 100; Puff et al., 1995: fig. 13; Delprete, 2009: figs. 3, 4) by the fusion of the epidermis of the sterile appendages (Puff et al., 1995), and this anther group is held erect directly over the mouth of the corolla tube. In this arrangement, the shortest filament is straight while the other filaments curve to accommodate their greater length, and all of the filaments are apparently under tension. The pollen is released at this stage (Hutchinson, 1915) in one or several clumps, but remains inside this ellipsoid anther group until one of the filaments is bumped by a pollinator, which triggers an explosive separation of the anthers and catapults the pollen "out to some distance" (Hutchinson, 1915: 306). In this action, the four anthers with the longer filaments move to a reflexed position, so these anthers are positioned with their dorsal side lying on or near the corolla lobes, while the shortest filament is flexed forward and its anther positioned to cover the mouth of the corolla tube. After about half a

day (Hutchinson, 1915: 306), the shortest filament changes to a reflexed position so its anther is then also positioned with its dorsal side lying on the remaining corolla lobe, and the corolla tube is again accessible to pollinators. The presence of the unequal filaments and this catapult mechanism is evident even when the flower is in bud, because the unequal filaments in part make the lobe portion of the corolla bud bent or deflected at about 30°–45° in relation to its tube (Delprete, 2009: fig. 3A). Similar asymmetric stamens, sterile anther appendages, and a pollen catapult mechanism are found in the monotypic genus *Molopanthera* of southeastern Brazil (Delprete, 2009), which appears to be closely related to *Posoqueria*. Additionally, in *Posoqueria* flowers the corolla lobes are often unequal in length, by as much as 30%, with one longest, two or three of medium length, and one or two of the shortest length. These unequal corolla lobes have not been detailed by previous taxonomic studies of this genus, probably at least in part due to most of those observations being based on dried herbarium specimens where unequal corolla lobe length may be an artifact of specimen preparation. The unequal size of the corolla lobes is evident in the corolla bud, and also makes the lobe portion of the corolla bud deflect or bend.

However, as noted by Delprete (2009), not all species of *Posoqueria* have an evidently asymmetric androecium or apparently the pollen catapult mechanism. These other *Posoqueria* species have anthers that are also borne in a coherent or weakly fused, ellipsoid group that is held erect in the center of the flower on filaments of equal or nearly equal length, with the anthers later separating and spreading and the filaments becoming slightly curved. However, in these species the filaments are generally straight in bud and generally equal in length (Taylor & Cortés-Ballén, 1999: fig. 1; Macias & Kinoshita, 2003: fig. 1), and in contrast to the species with an asymmetric androecium, their anthers are partially included in the corolla tube or just barely fully exserted from it (i.e., with the base of the anther positioned less than 1 mm above the top of the corolla tube). In these species, the lobe portion of the corolla bud is generally straight with respect to the tube, although in some of these species the corolla lobes are also unequal in size, so the corolla buds have the lobe portion bent or deflexed but usually only to 10°–20° with respect to the corolla tube.

Posoqueria has been studied taxonomically only regionally, with the exception of one study that has apparently not been published (Macias, 1988, unpublished thesis). Steyermark (1967) presented the general taxonomic concepts and species circumscriptions in use until now in Central America and northern South America, and he noted that *Posoqueria* was very poorly known and his observation is still accurate. Steyermark distinguished the *Posoqueria* species of northern South America and southern Central America based primarily on form and distribution of the pubescence of the leaves, corollas, and anthers. He circumscribed several species that included notably broad ranges of corolla size, such as *P. coriacea* M. Martens & Galeotti, with the corolla tubes 8.5–29 cm long, and *P. panamensis* (Walp. & Duchass.) Walp. with the corolla tubes 12.5–25 cm long (Steyermark, 1967). He also circumscribed species of *Posoqueria* to include plants with an asymmetric androecium, bent corolla buds, and the pollen catapult mechanism together with plants that lack these features. Steyermark noted variation in these androecium features, but considered all the flowers with short straight filaments and an actinomorphic androecium to be immature with the unequal filaments simply not yet expanded (1967: 329), rather than recognizing that the flowers were mature and different. Steyermark stated that this conclusion was based on Hutchinson's figure (1915: fig. 100); however, that figure clearly shows the developed, curving filaments of flowers with the catapult mechanism, rather than the short straight filaments of the flowers with the actinomorphic androecium. Since Steyermark's work, *Posoqueria* has been said to comprise species that all have an asymmetric androecium, or to include only one (Delprete, 2009) or a few (Macias, 1988) exceptional species with an actinomorphic androecium. However, as documented here, at least nine species of *Posoqueria* have an actinomorphic androecium without the pollen catapult mechanism and corolla buds with the lobe portion generally straight with respect to the tube. Presence versus absence of an asymmetric androecium and catapult pollination mechanism separates two groups of species: a set of species with a clearly asymmetric androecium, including *P. acutiflora* Mart., *P. coriacea*, *P. grandiflora* Standl., *P. latifolia*, *P. longifilamentosa* C. M. Taylor, *P. longiflora* Aubl., *P. maxima* Standl., *P. palustris* Mart., *P. trinitatis* DC., and *P. williamsii* Steyerm.; and a set of species with an actinomorphic androecium and apparently without the pollen catapult mechanism, including *P. bahiensis* Macias & Kin.-Gouv., *P. chocoana* C. M. Taylor (described in this article), *P. correana* C. M. Taylor (described in this article), *P. costaricensis* C. M. Taylor (described in this article), *P. grandifructa* Hammel & C. M. Taylor (described in this article), *P. laevis* C. M. Taylor, *P. mutisii* Standl., *P. robusta*

Hammel & C. M. Taylor (described in this article), and *P. tarairensis* C. M. Taylor & Cortés-Ballén.

Steyermark (1967) distinguished several species of *Posoqueria* based on the density and form of the pubescence on the anthers, and in some cases based also on the pubescence of basal appendages of the anthers. However, with more flowering collections available today, continuous variation in these features can be seen within several species, and Macias (1988) did not distinguish species based on anther characters. Steyermark also noted discontinuous variation in the length of the corolla tube, but considered corolla length to indicate varieties within a species rather than to characterize species. However, with more collections available now, a pattern is evident in corolla length, and this feature does seem to characterize species. In general, *Posoqueria* species with relatively small flowers, i.e., with the corolla tubes generally 6.5–12 cm long, are found in premontane, montane, dry, seasonal, and gallery forests (e.g., *P. bahiensis*, *P. coriacea*, *P. tarairensis*); species with medium-sized flowers, with the corolla tubes generally 12–20 cm long, are found in lowland to premontane wet forests (e.g., *P. chocoana*, *P. grandifructa*, *P. latifolia*); and species with relatively long flowers, with corolla tubes generally 22–36 cm long, are found in wet lowland forests (e.g., *P. grandiflora*, *P. longifilamentosa*, *P. maxima*, *P. williamsii*).

Steyermark (1967) did not consider the fruits to differ in form among *Posoqueria* species, or at least did not regard this variation as characterizing different species, and did not even mention fruit characters in his classification. In part this was no doubt due to the difficulty of matching fruiting and flowering specimens in this genus. Macias (1988) similarly gave little descriptive detail of the fruits and did not use them to distinguish any species. However, field observations show that in at least some cases *Posoqueria* species are characterized by differences among their fruits as well as their flowers. Fruit characters are thus incorporated into the new taxonomy presented here.

Notes on *Posoqueria panamensis* and *P. coriacea*

Steyermark (1967) included many plants from Central America and northern South America in *Posoqueria panamensis* (Walp. & Duchass.) Walp. He distinguished *P. panamensis* by its stipules 9–32 mm long, its firmly chartaceous to sometimes subcoriaceous leaves, its corolla tubes 12.5–25 cm long, and its anthers that are densely papillate to glabrous, from *P. latifolia* with its stipules 3–14 mm long, usually thickly coriaceous leaves, its corolla tubes 4–12 cm long, and its anthers that are glabrous to papillate. In Steyermark's circumscription, *P. panamensis* was a widespread heterogeneous species that was difficult to characterize morphologically or ecologically. Subsequent authors either synonymized *P. panamensis* with *P. latifolia* (Dwyer, 1980) or followed Steyermark's taxonomy and applied the name *P. panamensis* to all *Posoqueria* plants with rather large corollas and leaves that are not shiny on the adaxial surface when dry (Burger & Taylor, 1993; Taylor, 2001; Taylor et al., 2004; L. Macias in herb.). The name *P. panamensis* was based on a plant from Panama that has not been traced as a specimen or a figure, but can be interpreted based on the description in the protologue. This described the corolla buds as having the lobe portion bent and gibbous and the filaments well developed and of unequal length, as well as hooked at the apex: this description indicates that *P. panamensis* has flowers with an asymmetric androecium and pollen catapult mechanism, which produce the bent attitude of the lobe portion of the corolla bud; a bent or hooked apex is sometimes found on the old, reflexed filaments of *Posoqueria* species that have the pollen catapult mechanism. Additionally, the protologue describes *P. panamensis* as having shiny leaves and a corolla tube ca. 10 cm long. In the classification here of Central American *Posoqueria*, two species with an asymmetric androecium, shiny leaves, and corolla tubes of this size are known from Panama today: *P. coriacea* is rare in montane forests, and *P. latifolia* is widespread and common, both in the wild and cultivated, in lowland central Panama including in the Canal Zone, which is the most likely type locality for this name. The name *P. panamensis* is, therefore, here considered a synonym of the common lowland species *P. latifolia*, a conclusion similar to that of Macias (1988). In any case, *P. coriacea* also has priority over *P. panamensis*.

In contrast to the description in the protologue, numerous *Posoqueria* specimens from southern Central America and northwestern South America that have been included in *P. panamensis* by Steyermark (1967) and other recent authors mostly have flowers with actinomorphic androecia and leaves that are not shiny when dry. These misidentified plants are here separated into several newly described species: *P. chocoana*, *P. correana*, *P. costaricensis*, *P. grandifructa*, *P. longifilamentosa*, and *P. robusta*. Other *Posoqueria* specimens from northern South America that have been included in *P. panamensis* (e.g., Taylor et al., 2004; Steyermark, 1974), and that do have flowers with asymmetric androecia, have not been studied here; at least some

of these apparently are correctly called *P. trinitatis* (Macias, 1988).

In the southern part of Central America, *Posoqueria latifolia* is most similar to *P. coriacea*, and these two species are sympatric and sometimes difficult to distinguish at middle elevations. *Posoqueria coriacea* can be recognized by its stipules 3–9 mm long and its fruits 7–8 cm diam. with the walls 4–6 mm thick and the seeds 10–15 mm long, versus in *P. latifolia* the stipules 5–22 mm long and the smaller, thinner-walled fruits 3.5–5 cm diam. with the walls 1–3 mm thick and the seeds 4–8 mm long. Additionally, the calyx lobes help distinguish the two: in *P. latifolia* they are poorly developed, with the calyx limb nearly truncate or the lobes are short, broadly triangular, and have the margins minutely ciliolate and not overlapping at the sinus; in contrast, in *P. coriacea* the calyx lobes are clearly developed, broadly rounded, and have the margins ciliate and overlapping at the sinus.

Taxonomy and Methods

The new species described below are documented by specimens made by projects focused on floristic study of tropical forest regions that are not well known to science, with most of the collections made within the last 15 years. Additional collection data for the specimens cited here and high-resolution digital images of the type specimens are available on the Internet at <http://www.tropicos.org>. Because of the size of the flowers and fruits of *Posoqueria*, to facilitate comparisons among species the inflorescence and infructescence sizes in the descriptions here are measured without the corollas and fruits. Thus the measurements given for the inflorescences include the peduncle, axes, pedicels, ovaries, and calyx limbs, but not the corollas; the measurements given for the infructescences include the peduncle, axes, and pedicels.

Conservation status assessment methodology. The study presented here is taxonomic and floristic: the objective is enumeration of the species that belong to various Rubiaceae genera, and the species that occur in the area of tropical Central and South America. The methods employed correspond only to this objective, so this study is based on survey of specimens collected over a number of years using varied survey methods aimed at various objectives. The specimens used to delineate the range and commonness of these new species were located through a nonexhaustive survey of several herbaria, and no field studies have been done targeting the occurrence of these species where they are known or expected to grow. Thus the floristic information presented here is a simplified presence report based on incomplete survey of the available data, which are uneven and incomplete for this region (Schulman et al., 2007). Knowledge of the true geographic range and the population size and dynamics of a species is essential to understanding the threats to its existence, and thus to understanding its actual conservation status; documentation of the existence of a species based on one or several museum collections does not provide adequate data to evaluate these factors. Conservation assessments are provided here for these newly described species using IUCN categories and criteria (IUCN, 2001) based on the totality of our current knowledge. The basis for these assessments in the form of a map and the calculated assessment parameters are available under the corresponding species names at <http://www.tropicos.org> (assessment parameters for each map can be seen by clicking on the thumbnail map). The assessment parameters were calculated using the IUCN Rating tool (Moat, 2007) in ArcView GIS 3.2 (ESRI, 1999), with the grid cell size used for calculating Area of Occupancy (AOO) varied between 1 and 3.16 km depending on characteristics of the species and data (IUCN Standards and Petitions Working Group, 2008). These assessments are not being submitted to IUCN for publication on the Red List (<http://www.iucnredlist.org>), and the basis for these assessments should be carefully evaluated by the reader.

New Species of *Posoqueria*

1. **Posoqueria chocoana** C. M. Taylor, sp. nov. TYPE: Panama. Panamá: El Llano–Cartí rd. ca. 18 km from Pan Am. Hwy., 9°20′N, 79°00′W, 400 m, 28 Dec. 1982, *B. A. Stein 1046* (holotype, PMA; isotype, MO-3108923). Figure 1C, D.

Haec species a congeneris foliis subtenacibus, corolla magnitudine media lobis rectis usque in alabastro subdeflexis, antheris partim breviterve exsertis filamenta aequantibus atque fructu subgloboso usque ovoideo laevi distinguitur.

Small to medium-sized trees, flowering at 6 m tall, to 20 m tall; stems glabrous, apparently somewhat succulent. *Leaves* with *blade* elliptic, broadly elliptic, or ovate, 10–33.5 × 5–21 cm, apex acute to acuminate with tips to 2 cm or rarely obtuse, base obtuse to rounded or truncate, glabrous, drying papery to subcoriaceous, adaxially matte or slightly shiny, and often paler abaxially; secondary veins 4 to 7 pairs, plane to prominulous adaxially,

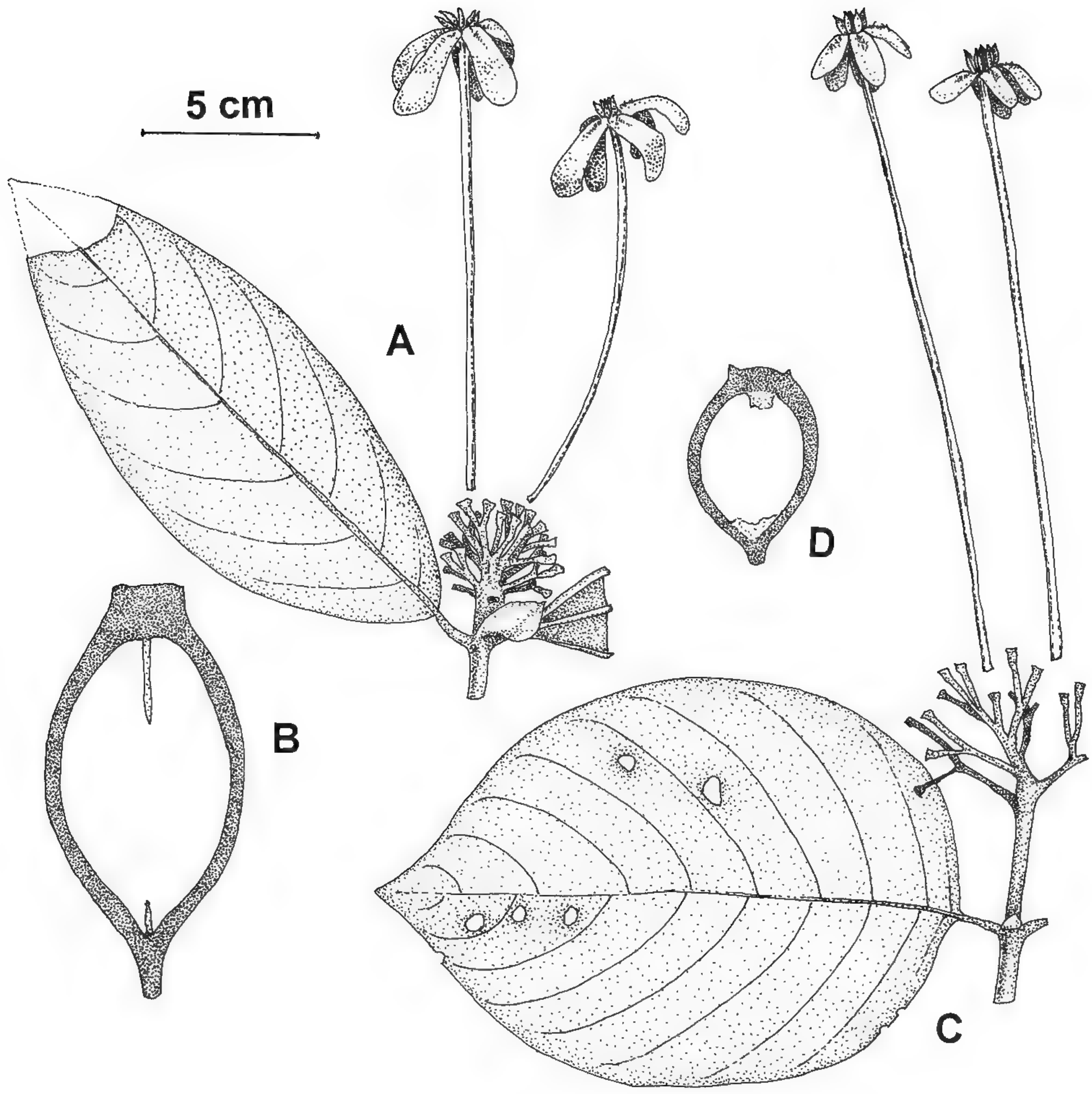

Figure 1. A, B. *Posoqueria correana* C. M. Taylor. —A. Portion of flowering stem, with flowers partially dissected; based on the type *Merello & González 3198* (MO). —B. Longitudinal section of fruit, perpendicular to septum, placentas and seed mass removed; based on the paratype *Herrera 1224* (MO). C, D. *P. chocoana* C. M. Taylor. —C. Portion of flowering stem, with flowers partially dissected; based on the paratype *Clark & Troya 502* (MO). —D. Longitudinal section of fruit, parallel to septum, placentas and seed mass removed; based on the paratype *Oliver et al. 3661* (MO).

prominulous abaxially, the costa plane to prominulous adaxially, prominent abaxially, the remaining venation plane and not visible on both sides; margins flat or usually thinly revolute; *petioles* 1–3 cm, stout, glabrous; *stipules* interpetiolar, elliptic to lanceolate or ligulate, 10–30 mm, obtuse to rounded, glabrous, sometimes longitudinally veined, deciduous. *Inflorescence* terminal, cymose, 4–8 × 4–7 cm (not including corollas or fruits), puberulous to glabrescent; bracts ligulate or ovate, 1–2 mm, obtuse; pedicels 3–10 mm. *Flowers* with ovary portion obconic, ca. 2 mm, glabrous; *calyx* limb 1.5–2 mm, lobed for ca. 1/4, glabrous, lobes broadly triangular, obtuse to rounded, entire or ciliolate, marginally often hyaline; *corolla* in bud with lobes straight or slightly deflexed, at anthesis white, salverform, externally glabrous, tube 135–175 mm, 2–3 mm diam., hirtellous in throat and onto bases of lobes, lobes 5, narrowly elliptic, obtuse to rounded, the shortest lobe 16–17 mm, the longest lobe 19–20 mm; *stamens* with filaments 2–2.2 mm, equal or slightly unequal, inserted 1–1.5 mm below top of corolla tube, anthers narrowly oblong to fusiform, ca. 6 mm, abaxially shortly puberulous, at apex and base with narrowly triangular sterile appendage ca. 1 mm; *stigmas* not seen. *Fruit* subglobose to ovoid, 5–7 × 5–7 cm, becoming white then brown, smooth perhaps becoming slightly roughened; mesocarp woody or leathery, 3–4 mm thick; seeds ca. 1 cm, broadly angled.

Habitat, distribution, and phenology. *Posoqueria chocoana* is known from wet forests at 0–700 m from central Panama to central-western Ecuador and was collected with flowers in March and June through September and with fruits in January, August, September, November, and December.

IUCN Red List category. *Posoqueria chocoana* fails to meet the geographic range criterion for any threatened category, and it is documented from four legally protected areas in two countries. This species is here evaluated as Least Concern (LC), although if habitats in its region of distribution including in these protected areas begin to decline then this species could be considered Near Threatened or even Vulnerable.

Discussion. This new species is distinguished by its combination of often rather leathery leaves with stout petioles and the higher-order venation not visible, its medium-sized corollas (for *Posoqueria*) with the lobes slightly unequal in length on an individual flower and straight or slightly deflexed in bud, its partially included to shortly exserted anthers on filaments of generally equal lengths, and its subglobose to ovoid, generally smooth fruits. This new species is known from a range that generally corresponds to the Chocó biogeographic region of northwestern South America and eastern Panama (Gentry, 1982), and the specific epithet refers to this distribution.

This new species has previously been identified as *Posoqueria panamensis*; see the discussion in the introduction of the taxonomic problems with the circumscription of that species. *Posoqueria chocoana* is similar to *P. grandifructa*, described later in this article, but *P. grandifructa* can be separated by its usually narrower leaves (4–14 cm wide), its usually shorter stipules (5–13 mm long), its flowers with the ovary portion larger (ca. 4 mm long), its corollas with stouter tubes (2.5–4 mm diam.), and its larger ellipsoid fruits (to 13 × 9 cm with the mesocarp 5–8 mm thick). Also similar to this new species is *P. correana*, described later in this article, which can be separated by its leaves that are densely velutinous abaxially, its smaller corollas with the tube 11–13 cm long, and its larger ellipsoid fruits (to 12 × 5.5 cm with the mesocarp ca. 5 mm thick).

Paratypes. CENTRAL AMERICA. PANAMA. **Colón:** Parque Nac. Portobelo, ribera del Río Guanche, *C. Galdames & C. Guerra 1903* (MO, SCZ), *C. Galdames & J. Aranda 4107* (MO, SCZ); along Río Guanche, E of Colón, *H. Kennedy & R. Foster 2196* (MO), *G. McPherson 8504* (MO), *E. Montenegro & D. Taylor 1912* (MO), *K. J. Sytsma 1648* (MO). **Darién:** Camp Summit, adjacent [to] Darién San Blas border along Sea Level Canal Rte. 17, *R. L. Oliver, W. H. Blackwell, Jr. & J. W. Nowicke 3661* (MO). **Panamá:** El Llano–Cartí rd., *K. J. Sytsma 1049* (MO), 1 mi. past sawmill, *T. Antonio 2528* (MO); ca. 17 km from Pan Am. Hwy., *S. Knapp 1356* (MO), near border San Blas, *G. McPherson 9775* (MO), lado Pacífico de la Cordillera de San Blas, cabecera del río Piria (Piriati), *H. Herrera, J. Mojica & J. Morris 1156* (MO). **San Blas [Kuna Yala]:** río Playón Chico, hacia el sendero que cruza la Cordillera de San Blas, *H. Herrera 1771* (MO, PTBG); Cerro Brewster, headwaters of río Cangandí, *G. de Nevers, H. Herrera, B. Hammel & S. Charnley 5518* (MO). **Veraguas:** NW of Santa Fe, 11 km from Escuela Agrícola de Piedra, in valley of Río Dos Bocas, Atlantic slope, *S. Mori & J. Kallunki 3894* (MO).

SOUTH AMERICA. COLOMBIA. **Chocó:** Parque Nac. de Utría, en la falda de la serranía que bordea el río San Pichí, *F. García C. & E. D. Agualimpia 476* (CHOCO, MO). ECUADOR. **Carchi:** cantón Tulcán, Reserva Etnica Awá-Canynbí, Chical, *C. Quelal, C. Aulestia & F. Nastacuáz 235* (MO, QCNE). **Esmeraldas:** cantón Quinindé, Bilsa Biol. Station, Mache Mtns., 35 km W of Quinindé, 5 km W Santa Isabel, *J. L. Clark 176* (MO, QCNE), *J. L. Clark & Y. Troya 502* (MO, QCNE), *D. Neill & QCNE Botany Interns 12226* (MO, QCNE), *W. Palacios, J. [L.] Clark & N. Jaramillo 13558* (MO, QCNE). **Los Ríos:** cantón Quevedo, Cerro Centinela, Montañas de Ila, 10 km al E Patricia Pilar, *W. Palacios & E. Freire 7432* (MO, QCNE). **Manabí:** cantón Pedernales, Bosque Protector Cerro Pata de Pájaro, 15 km SE Pedernales, *D. Neill & QCNE Botany Interns 11338* (MO, QCNE); ca. 10 km E Pedernales, *N. Pitman 1321* (MO), *H. Vargas 1283* (MO, QCNE).

2. Posoqueria correana C. M. Taylor, sp. nov. TYPE: Panama. Colón: Teck Cominco Mining Concession, Camp Colina, along Quebrada Colina, 8°50′N, 80°40′W, 152 m, 3 Mar. 2008, *M. Merello & J. I. González 3198* (holotype, PMA; isotype, MO-6120458). Figure 1A, B.

Haec species a congeneris foliis abaxialiter dense velutinis, corolla magnitudine media lobis rectis usque in alabastro subdeflexis, antheris partim breviterve exsertis filamenta aequantibus atque fructu grandi ellipsoideo distinguitur.

Small trees, flowering at 3 m tall, to 10 m tall; stems glabrous. *Leaves* with *blade* ovate, elliptic, or narrowly elliptic, 14.5–36 × 7.5–24 cm, apex acute to usually acuminate with slender tips to 1.5 cm, base obtuse to rounded or shortly truncate, adaxially glabrous, abaxially densely velutinous, drying chartaceous to subcoriaceous and rather shiny adaxially; secondary veins 4 to 7 pairs, plane to sulcate adaxially, prominent abaxially, the costa prominent to prominulous adaxially, prominent abaxially, the remaining veins plane and not visible on both surfaces; margins thinly to markedly revolute; *petioles* 0.8–2.2 cm, puberulous to glabrous; *stipules* interpetiolar, ligulate to elliptic or broadly elliptic, 12–27 mm, glabrous, obtuse to rounded, on vegetative nodes deciduous. *Inflorescence* terminal, subfasciculate to shortly cymose, 2–4 × 2–5 cm (not including corollas

or fruits), glabrous, with subtending stipules persistent until anthesis then quickly deciduous; bracts few, triangular or ligulate, 1–2 mm; pedicels 2–18 mm. *Flowers* with ovary portion ellipsoid-cylindrical, 3–4 mm, glabrous; *calyx* limb 2–2.5 mm, glabrous, 5-lobed shallowly or for up to 1/4, lobes broadly rounded to triangular, obtuse, entire to ciliolate; *corolla* in bud with lobes straight or slightly deflexed, at anthesis white, salverform, externally glabrous, tube 110–130 mm, 2–2.5 mm diam., hirtellous in throat and onto midrib of lobes, lobes 5, ligulate or oblanceolate, adaxially glabrous or densely puberulous, obtuse to rounded, entire, the shortest lobe 19–23 mm, the longest lobe 24–30 mm; *stamens* with filaments 2.5–3 mm, equal or a little unequal, inserted ca. 2 mm below top of corolla tube, anthers narrowly ellipsoid to fusiform, 6–7 mm, partially to shortly exserted, abaxially granular-puberulous, at apex and base with narrowly triangular sterile appendage 0.8–1 mm; stigmas linear, ca. 2 mm. *Fruit* ellipsoid, to 12 × 5.5 cm, mature color unknown, smooth or becoming roughened-lenticellate; mesocarp leathery or woody, ca. 5 mm thick; seeds 1–1.3 cm, broadly angled.

Habitat, distribution, and phenology. *Posoqueria correana* is known from wet forests at 50–880 m in central Panama, and has been collected with flowers in March and September and with fruits (perhaps immature) in September and October.

IUCN Red List category. *Posoqueria correana* meets the geographic range criterion for an evaluation of Endangered based on its limited known Extent of Occurrence (EOO) and AOO. However, it is found in three different legally protected areas, presumably not all under immediate threat. Whether its habitat or populations are in continuing decline is unconfirmed, but this is likely, now or in the near future. This species is here evaluated as Vulnerable due to its few known locations that may have declining habitat (VU D2).

Discussion. This new species can be recognized by the combination of its leaves that are densely velutinous abaxially, rather shiny adaxially when dry with the higher-order venation not visible, and usually with a slender sharp tip; its usually compact inflorescence subtended by well-developed, rounded stipules that persist through anthesis and with well-developed pedicels that are often longer than the secondary and tertiary axes; its medium-sized (for *Posoqueria*) corollas with the lobes straight to slightly deflexed in bud; its anthers partially included to very shortly exserted on filaments of generally equal length; and its large, thick-walled fruit. This new species is only known from Panama, and is named in honor of Panamanian botanist Mireya D. Correa, who has significantly advanced knowledge of the Panamanian flora and development of botanical infrastructure (herbaria, databases, and maps) and collaboration throughout Central America as well as training many younger botanists.

This new species is similar in general aspect to *Posoqueria coriacea*, and has been confused with that species; however, *P. coriacea* can be separated by its leaves that are glabrous or puberulous abaxially (in Panama), its corollas with the lobes markedly unequal and deflexed in bud, its anthers well exserted on markedly unequal filaments, its subglobose smooth fruits, and its habitat in premontane and montane vegetation. Also similar to this new species are *P. grandiflora*, which can be separated by its larger corollas with the tube 260–360 mm long and the lobes markedly deflexed in bud, and its anthers well exserted on markedly unequal filaments; and *P. grandifructa*, which can be separated by its leaves that are glabrous abaxially and usually more papery, its acute stipules with those subtending the inflorescence deciduous at the beginning of anthesis, and its often larger corollas with the tube 125–155 mm long.

Paratypes. PANAMA. **Coclé:** 7 km N of El Copé, near Rivera Sawmill, *J. P. Folsom 5238* (MO, PTBG); división cont. arriba del Barrigón y el aserradero viejo, camino de caballo a Coclesito, *M. Peña, R. Foster, R. Pérez, S. Aguilar, A. Hernández, Z. Batista & R. Mihalik 394* (F, MO, PMA). **San Blas [Kuna Yala]:** vecindad de Yannuadi, frente a la Isla de Narganá, a 5 km de la costa, *H. Herrera, B. Obaldia & D. Escobar 1224* (MO, PMA).

3. Posoqueria costaricensis C. M. Taylor, sp. nov. TYPE: Costa Rica. Alajuela: Reserva Biol. Monteverde, Río Peñas Blancas, 10°18′N, 84°45′W, 900 m, 15 May 1987, *W. Haber & E. Bello 7037* (holotype, CR; isotypes, DUKE-333971, INB-566355, MO-3715245). Figure 2C, D.

Haec species a congeneris corolla sat brevi lobis plerumque in alabastro rectis atque antheris partim inclusis usque breviter exsertis erectis filamentis brevibus insidentibus distinguitur.

Small trees, flowering at 2.5 m tall, to 10 m tall; stems glabrous. *Leaves* with *blades* elliptic, lanceolate, or narrowly elliptic-lanceolate, 6.5–17 × 2.2–6.2 cm, apex acute to acuminate with tip to 0.8 cm, base acute to obtuse, glabrous, drying papery to coriaceous and adaxially matte to shiny; secondary veins 4 to 6 pairs, prominulous on both surfaces, the costa prominulous adaxially, prominent abaxially,

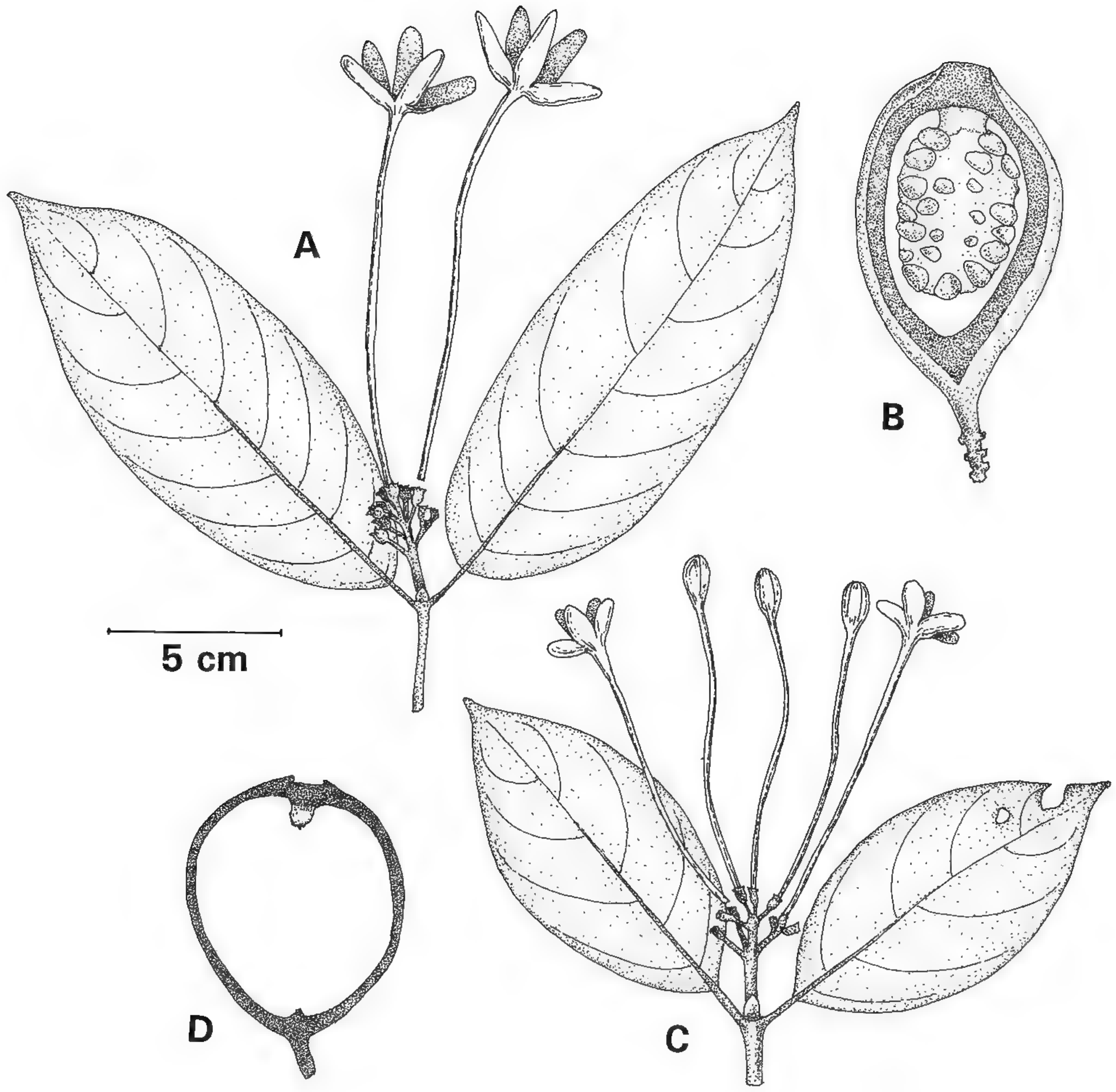

Figure 2. A, B. *Posoqueria grandifructa* Hammel & C. M. Taylor. —A. Portion of flowering stem, right-hand flower partially dissected; based on the paratype *Stevens 23665* (MO). —B. Longitudinal section of fruit, parallel to septum; based on the paratype *McDowell 726* (DUKE). C, D. *P. costaricensis* C. M. Taylor. —C. Portion of flowering stem; based on the type *Haber & Bello 7037* (MO). —D. Longitudinal section of fruit, perpendicular to septum, placentas and seed mass removed; based on the paratype *McPherson 12538* (MO).

the remaining veins plane and not or sparsely visible adaxially, plane or sparsely raised abaxially; margins plane to thinly revolute; *petioles* 5–15 mm, glabrous; *stipules* interpetiolar, triangular, ligulate, or lanceolate, 5–9 mm, acute, glabrous, often with well-marked longitudinal striations or veins, deciduous below terminal 1 to 2 nodes. *Inflorescence* terminal, cymose, 2.5–6 × 1.5–5 cm (not including corollas or fruits), pilosulose to glabrous; bracts ligulate to ovate, 0.3–2 mm; pedicels 5–15 mm. *Flowers* with ovary portion ellipsoid-obconic, 2–3.5 mm, glabrous; *calyx* limb 1–1.5 mm, glabrous, almost truncate to 5-lobed for up to 1/3, lobes broadly rounded to triangular, with margins minutely papillose-ciliolate and often hyaline; *corolla* in bud with the lobes held more or less straight with respect to the tube, at anthesis white, salverform, externally glabrous, tube 70–90 mm, 1–2 mm diam., sparsely to densely hirtellous in throat and sometimes onto lobes, lobes 5, elliptic to ligulate, obtuse to rounded, entire, the shortest lobe 11–13 mm, the longest lobe 12–15 mm; *stamens* with filaments ca. 2 mm, equal or a little unequal, inserted ca. 1 mm below top of corolla tube, anthers narrowly ellipsoid, ca. 4 mm, partially included to shortly exserted, abaxially puberulous, at base with triangular acute sterile portion ca. 0.8 mm, at apex with triangular acute sterile portion ca. 1 mm; *stigmas* linear, 2–3 mm. *Fruit* subglobose, 6.5–8 × 6.5–8 cm, externally slightly to markedly roughened, brown and slightly crustose; mesocarp woody, 4–5 mm thick; seeds angled, 1–1.5 cm, smooth.

Habitat, distribution, and phenology. *Posoqueria costaricensis* is known from wet and premontane forests at 800–1760 m in Costa Rica and Panama and has been collected with flowers in January, February, and May and with apparently mature fruits in April, August, and December.

IUCN Red List category. *Posoqueria costaricensis* meets the geographic range criterion for an evaluation of Vulnerable due to its limited EOO and not more than 10 locations (i.e., different threat regimes), and for Endangered due to its limited AOO. It is known from three legally protected areas in two countries. There is no clear documentation of ongoing continuing decline in the habitat of these particular protected areas; however, this species seems to occupy a relatively narrow elevational zone in wet forest that is generally in significant decline throughout this region, therefore this species is here assessed as Vulnerable due to habitat decline (VU B1ab[iii] + 2ab[iii]).

Discussion. This new species can be recognized by the combination of its calyx limb that is nearly truncate or shallowly lobed with the lobes broadly rounded and marginally papillose-ciliolate, its medium-sized (for *Posoqueria*) corollas with the lobes held more or less straight in bud, its anthers that are partially included or only barely exserted on filaments of generally similar length, and its subglobose fruits with rather thick woody walls that become brown and slightly crustose on the outside. This new species has previously been included in *P. panamensis*; see the discussion in the introduction of the taxonomic problems with the circumscription of that species.

Posoqueria costaricensis apparently may be locally sympatric with *P. coriacea*, and without flowers or fully mature fruits these two species can be difficult to distinguish. With flowers, *P. coriacea* can be recognized by its distinctive calyx lobes that are marginally ciliate and broadly rounded with the basal margins often overlapping in the sinus and its asymmetric androecium with the anthers well exserted on filaments of unequal length. The fruits of *P. coriacea* apparently remain green and smooth at maturity, while those of *P. costaricensis* become brown and slightly crustose. Although many of the specimens of *P. costaricensis* have the dried leaves matte on the adaxial surface, others (e.g., *Alfaro 493*, *Quesada 1719*, *Rodríguez et al. 10107*) have somewhat shiny leaves that are thus similar to those of *P. coriacea*. See also the discussion of *P. grandifructa*, described later in this article, which is also found in Costa Rica; *P. grandifructa* can be separated by its usually more papery leaves and its corollas similar to those of *P. costaricensis* but with longer tubes (105–155 mm), and is found at mostly lower elevations on the Caribbean slopes of Costa Rica and Nicaragua.

Paratypes. COSTA RICA. **Alajuela:** Bosque Eterno de los Niños, Río Peñas Blancas, Quebrada Gata, Los Pérez, *E. Bello, W. Haber, W. Zuchowski & J. Sibaja 2189* (INB); Reserva Biol. Monteverde, Río Peñas Blancas, Finca García, *W. Haber & E. Cruz 7716* (CR, MO). **Guanacaste:** Río Negro ford on S side of Lake Arenal, 10 km NNE of Santa Elena, *W. A. Haber ex E. Bello C., L. Lierheimer & B. Hammel 4880* (DUKE, PTBG). **Puntarenas:** Sabanas Esperanza, Biolley, *Javier Quesada 1719* (INB); Potrero Grande, Tres Colinas, bajando hacia Helechales, *A. Rodríguez, D. Solano & D. Santamaría 10107* (INB); Las Cruces Botanical Garden, near San Vito, *T. B. Croat 44385* (MO), *R. L. Wilbur, F. Almeda & T. Daniel 22824* (DUKE). **San José:** cantón de Pérez Zeledón, Cordillera de Talamanca, Las Nubes, Estación Santa Elena, *E. Alfaro 493* (INB, MO). PANAMA. **Bocas del Toro:** Fortuna Dam area, Oleoducto rd. near Cont. Divide, *H. W. Churchill, G. de Nevers & H. Stockwell 4695* (MO, PTBG), *G. McPherson & J. Aranda 10164* (MO); along rd. toward Chiriquí Grande, along trail leaving rd. at 500 m, *G. McPherson 12538* (MO).

4. Posoqueria grandifructa Hammel & C. M. Taylor, sp. nov. TYPE: Costa Rica. Heredia: cantón Sarapiquí, Finca La Selva, OTS biological station on the Río Puerto Viejo just E of jct. with Río Sarapiquí, ca. 100 m, 22 Feb. 1981, *J. Folsom 9100* (holotype, MO-3417484; isotype, DUKE-28904). Figure 2A, B.

Haec species a *Posoqueria latifolia* (Rudge) Roem. & Schult. corollae lobis in alabastro plerumque rectis, antheris partim inclusis vel perbreviter exsertis filamenta aequantibus atque fructu sat grandi ellipsoideo subfusiformive extus asperato lepidotove distinguitur.

Shrubs or small trees flowering at 2.5 m tall, to 8 m tall; stems puberulous to glabrous, often apparently rather succulent and becoming longitudinally finely wrinkled when dried. *Leaves* with *blade* elliptic, narrowly elliptic, or lanceolate-elliptic, 11–26 × 4–14 cm, apex acute to acuminate with tips to 0.8 cm, base obtuse to rounded or truncate, glabrous or often abaxially puberulous at least along principal veins, drying stiffly papyraceous to stiffly chartaceous and adaxially matte; secondary veins 4 to 7 pairs, visible and plane or raised adaxially, prominulous abaxially, the costa thinly prominulous adaxially, prominent abaxially, the remaining veins not visible or sometimes visible and plane to raised adaxially, not visible or sometimes sparsely visible abaxially; margins flat or thinly revolute; *petiole* 5–15 mm, glabrous; *stipules* interpetiolar, ligulate to narrowly triangular, 5–13 mm, acute, glabrous, often longitudinally ridged or

veined, caducous. *Inflorescences* terminal, cymose, 2.5–5 × 2–4 cm (not including corollas or fruits), puberulous to glabrous; bracts few, triangular, 0.5–2 mm, acute; pedicels 3–10 mm. *Flowers* with ovary portion ellipsoid-cylindrical, ca. 4 mm, glabrous; *calyx* limb 1–2 mm, glabrous, 5-lobed for ca. 1/2, lobes broadly triangular, acute to rounded, with margins entire or ciliolate, often hyaline; *corolla* in bud with lobes generally straight, at anthesis white, salverform, externally glabrous, tube (105–)125–155 mm, 2.5–4 mm diam., hirtellous to pilose in throat and sometimes onto lobes, lobes 5, narrowly ligulate, obtuse to rounded, entire, the shortest lobe 17–20 mm, the longest lobe 30–37 mm; *stamens* with filaments ca. 3 mm, equal or slightly unequal, inserted 2–3 mm below top of corolla tube, anthers lanceoloid, ca. 6 mm, partially included to just exserted, abaxially puberulous, at base with triangular acute sterile portion ca. 1 mm, at apex with triangular acute sterile portion ca. 1 mm; stigmas not seen. *Fruits* ellipsoid to somewhat fusiform, to 13 × 9 cm, dull brown, leathery, outside becoming roughened or scaly; mesocarp leathery to woody, 5–8 mm thick; seeds angled, 1–1.5 cm.

Habitat, distribution, and phenology. *Posoqueria grandifructa* is known from wet and premontane forests at 10–1000 m on the Caribbean slopes of Nicaragua and Costa Rica and rarely (*A. F. Skutch 2805*) on the Pacific slopes of Costa Rica; it has been collected with flowers in January, February, April, August, and September, and with fruits January, March, and June through December.

IUCN Red List category. *Posoqueria grandifructa* does not meet the geographic range criterion for any threatened category due to its relatively large EOO, and with more than 10 locations, the somewhat limited AOO is not a risk factor. This species is known from nine legally protected areas and one private protected area in two countries, and apparently is common locally and grows in secondary woody vegetation. There is ongoing habitat decline in its habitat throughout this region; however, due to its failure to meet the thresholds for any threatened category, together with the frequency of its recent collection, this species is here considered Least Concern (LC).

Discussion. This new species can be recognized by the combination of its leaves that are matte on the adaxial surface at least when dry and are often puberulent on the abaxial surface along the costa and often also the secondary veins, its relatively large corollas with the lobes generally straight in bud, its anthers that are partially included to just exserted on generally equal filaments that are inserted below the top of the corolla tube, and its relatively large, ellipsoid, thickly leathery- to woody-walled fruits that become markedly roughened at maturity. The specific epithet refers to these distinctive large mature fruits. The immature fruits of *Posoqueria grandifructa* are generally subglobose and smooth, then during development the calyx limb scar enlarges in diameter, the apical portion begins to elongate, and the surface becomes roughened. This new species has previously been identified as *P. panamensis*; see the discussion in the introduction of the taxonomic problems with the circumscription of that species.

Posoqueria grandifructa is similar to the sympatric species *P. latifolia*, but *P. latifolia* can be recognized by its leaves that are usually shiny on the adaxial surface when dry, its corolla buds with the lobe portion deflexed at 30°–45° with respect to the tube, its anthers fully exserted on well-developed flexuous filaments of unequal length, and its smaller subglobose fruits (3.5–5 cm diam.) with rather thin, stiffly chartaceous to thinly woody walls. *Posoqueria grandifructa* is even more similar to *P. costaricensis*, described previously in this article, with which it shares the symmetric, nonexplosive androecium and relatively large crustose fruits, and these two species are sometimes locally sympatric at the extremes of their elevational ranges. However, *P. grandifructa* can be recognized by its usually larger leaves that are often puberulent abaxially and its longer corolla tubes (105–155 mm), in contrast to the leaves glabrous abaxially and the corolla tubes shorter (70–90 mm long) in *P. costaricensis*.

Some plants of *Posoqueria grandifructa* from the Cordillera de Tilarán, at the uppermost elevation of the range reported here for this species (*Herrera 509*, *Herrera & Solís 444*), differ from the plants of lower elevations and other regions in having leaves that are truncate at the base and corolla lobes that are elliptic with the margins rounded, but the flowers of all of these plants are similar.

Paratypes. COSTA RICA. **Alajuela:** Parque Nac. Arenal, Cerro Chato, *A. Rodríguez, V. Ramírez & G. Soto 6251* (INB); Reserva Forestal de Arenal, Monteverde, Río Aguas Gatas, Finca Ulate, *E. Bello 1878* (CR, INB, MO); Reserva Biol. Monteverde, Río Peñas Blancas, Bosque Eterno de Los Niños, *E. Bello 2049* (INB); Reserva Biol. Monteverde, San Ramón, Est. Alemán's, *E. Bello, E. Cruz & R. Cruz 4060* (INB), *W. Haber & E. Cruz 8004* (CR, MO); entrada de la Reserva Forestal de San Ramón, camino a la colonia Palmareña, margen derecha río San Lorenzito, finca de Don Bolívar Ruíz, *G. Herrera Ch. 509* (CR, MO), *G. Herrera Ch. & A. Solís B. 444* (MO, PTBG). **Heredia:** Parque Nac. Braulio Carrillo, Fila Carrillo, *L. G. [L. D.] Gómez, I. A. Chacón & G. Herrera 21148* (CR, DUKE, MO); Quebrada González, *V. Ramírez 458* (INB, MO); cantón de Sarapiquí, Finca La Selva, OTS biol. station at jct. of ríos

Sarapiquí & Puerto Viejo (former property of L. Holdridge), *W. Burger & G. Matta U. [G. Mata U.] 4255* (F, MO), *J. Folsom 8888* (DUKE, MO), *9280* (DUKE), *9876* (DUKE), *B. Hammel 8443* (DUKE), *10108* (DUKE), *B. Hammel & J. Trainer 13146* (DUKE), *G. S. Hartshorn 900* (MO), *B. Jacobs 2228* (DUKE), *2428* (DUKE), *R. Kriebel, N. Zamora & R. Aguilar 3520* (INB), *T. McDowell 726* (DUKE, MO), *P. A. Opler 41* (MO), *D. [A.] Smith 47* (DUKE), *R. L. Wilbur & G. Moore 70201* (DUKE); Parque Nac. Braulio Carrillo, Est. Magsasay, *A. Fernández 82* (INB), *B. Hammel, A. Gentry & H. Kennedy 17827* (CR, MO); entre Bijagual y Magsasay, *L. D. Vargas, A. Rodríguez & E. Ureña 41* (INB, MO); Llanura de San Carlos, Caño Negro del sur, *B. Hammel, A. Rodríguez & V. Ramírez 21199* (INB); Guápiles, *V. Ramírez 458* (INB, MO); Rara Avis, ca. 15 km al SO de Horquetas, *O. Vargas 264* (CR, MO). **Limón:** Cerro Coronel, *W. D. Stevens 23665* (MO), *W. D. Stevens, G. Herrera & O. M. Montiel 24762* (MO), *24827* (MO); cantón de Pococí, R.N.F.S. Barra del Colorado, Llanura de Tortuguero, Sandinas, *F. Araya 597* (INB, MO); Parque Nac. Tortuguero, Est. Agua Fría, *R. Robles 1235* (CR, MO), *J. Solano 58* (INB, MO), *246* (INB, MO); cantón de Limón, Cerro Muchilla, Fila Matama, *R. Robles & A. Chacón 2663* (CR, MO); cantón de Talamanca, Sukut, ca. de juntas de ríos Urén y Sukut, *G. Herrera 3216* (CR, MO); at Recope site near Bribri, near Panama border, *C. M. Taylor & C. Skotak 4451* (DUKE). **San José:** vic. of El General, *A. F. Skutch 2805* (MO). NICARAGUA. **Río San Juan:** sobre río San Juan en caño el Sarnoso, 1 hora río abajo del pueso de MARENA, Bartola, *R. Rueda, B. Hernández & E. Palma 1982* (HULE, MO); mpio. del Castillo, Reserva Indio-Maíz, a lo largo del caño Chontaleño, *R. Rueda, I. Coronado, O. Aráuz & F. Flores 5886* (HULE, MO), *6018* (HULE, MO), *6151* (HULE, MO). **Zelaya:** ca. de Colonia Yolaina, *M. Araquistain 3117* (MO), *W. D. Stevens 6455* (MO); Monkey Point, *P. P. Moreno & J. C. Sandino 12267* (MO); al E del poblado de Nueva Atlanta, *R. Rueda, B. Hernández & I. Coronado 3280* (HULE, MO); río Punta Gorda, al S de San José, *R. Rueda, B. Hernández & I. Coronado 3658* (HULE, MO); Cerro El Escobín, 4 km de Colonia Serrano, *J. C. Sandino 3388* (MO).

5. **Posoqueria longifilamentosa** C. M. Taylor, sp. nov. TYPE: Ecuador. Esmeraldas: cantón Muisne, San Salvador, orillas del río Sucio, 100–150 m, [without day] Mar. 1995, *W. Palacios 13759* (holotype, QCNE; isotype, MO-5194790). Figure 3C, D.

Haec species a congeneris foliorum venis secundariis numerosis, venatione tertiaria quaternariaque subtiliter reticulata adaxialiter tenuiter prominente, corolla sat grandi, filamentis longis, antheris grandibus atque seminibus sat parvis distinguitur.

Small trees, flowering at 3 m tall, to 6 m tall; stems glabrous, apparently rather succulent, frequently becoming longitudinally finely wrinkled when dried. *Leaves* with *blade* elliptic or elliptic-oblong, 26.5–43 × 11–20 cm, apex shortly acuminate with tips to 0.8 cm, base obtuse to rounded, glabrous, drying thinly papery to chartaceous, adaxially matte, and pale abaxially; secondary veins 7 to 10 pairs, plane, thinly prominulous, or sulcate adaxially, prominulous abaxially, the costa plane or thinly prominulous adaxially, prominulous abaxially, the remaining veins finely reticulated and thinly raised adaxially, plane and not visible or sometimes sparsely visible abaxially; margins flat to thinly revolute; *petioles* 1.2–2.5 cm, glabrous; *stipules* interpetiolar, hastate sometimes above a rectangular basal portion, 4–20 mm, obtuse to acute, glabrous, sometimes longitudinally ridged or veined, deciduous. *Inflorescence* terminal, cymose, 4–7 × 4–7 cm (not including corollas or fruits), glabrous; bracts few, ligulate to elliptic, 1–4 mm, rounded, entire or ciliolate; pedicels 5–30 mm. *Flowers* with ovary portion obconic, 4–5 mm, glabrous; *calyx* limb ca. 2 mm, puberulous or glabrous, 5-lobed for 1/4–1/2, lobes rounded, with margins ciliolate; *corolla* in bud with lobes deflexed, at anthesis white, salverform, externally glabrous, tube 269–272 mm, 2–3.5 mm diam., hirtellous in throat and onto basal part of lobes, lobes 5, ligulate to narrowly elliptic, adaxially puberulous, obtuse to rounded, entire, the shortest lobe 28–30 mm, the longest lobe ca. 40 mm; *stamens* with filaments unequal, the shortest ca. 10 mm, the longest ca. 20 mm, anthers narrowly lanceoloid, 10–11 mm, exserted, abaxially densely puberulous, at apex and base with narrowly triangular sterile appendages ca. 2 mm; *stigmas* not seen. *Fruits* subglobose, 4.5–5 × 4.5–5 cm, mature color unknown, smooth perhaps becoming roughened; mesocarp leathery to woody, 2–3 mm thick; seeds 0.5–0.8 mm, broadly angled.

Habitat, distribution, and phenology. *Posoqueria longifilamentosa* is known from wet forest at 100–470 m in northwestern coastal Ecuador; it has been collected with flowers in March and May, and with fruits (though perhaps these are immature) in March and April.

IUCN Red List category. *Posoqueria longifilamentosa* meets the geographic range criterion for Endangered based on its limited EOO and AOO, in addition to its no more than five locations (i.e., distinct threat regimes). It is known from one national legally protected area and one indigenous-managed reserve. Although no ongoing significant decline in these protected areas has been documented, the vegetation in this region is under threat from development. However, this area is not well explored botanically and this species could be more common than specimen representation suggests. This species is here considered Vulnerable due to its few known locations that may have declining habitat (VU D2).

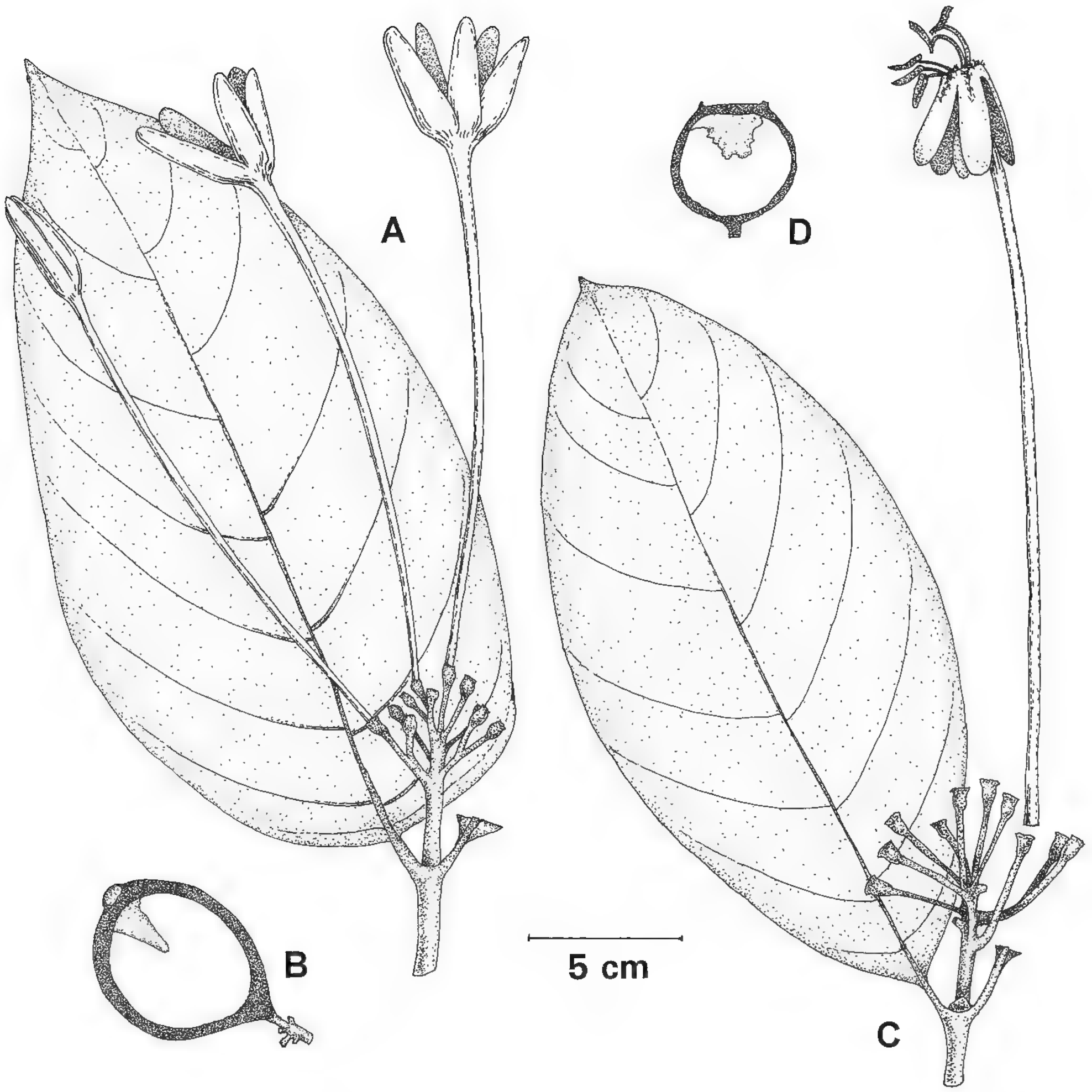

Figure 3. A, B. *Posoqueria robusta* Hammel & C. M. Taylor. —A. Portion of flowering branch; based on the paratype *Folsom 9172* (MO). —B. Longitudinal section of fruit, parallel to septum, placentas and seed mass removed; based on the paratype *Ramírez et al. 216* (MO). C, D. *P. longifilamentosa* C. M. Taylor. —C. Portion of flowering branch, flower partially dissected; based on the paratype *Clark et al. 4205* (MO). —D. Longitudinal section of fruit, parallel to septum, placentas and seed mass removed; based on the paratype *Rubio & Quelal 1390* (MO).

Discussion. This new species can be recognized by its leaves drying pale abaxially and with the higher-order venation finely reticulated and raised on the adaxial surface, its hastate stipules, its relatively long corollas, its asymmetric androecium with the filaments and anthers larger than in any other species of the genus, and its smooth subglobose fruits. The specific epithet refers to the relatively long filaments. This new species is only known from a rather small area in northwestern Ecuador, but probably should be expected also in adjacent western Colombia.

Paratypes. ECUADOR. **Esmeraldas:** Reserva Mache-Chindul, Cordillera Ene, ca. a la propiedad de Luis Cabrera, *C. Bonifaz & [X.] Cornejo 5043* (GUAY, MO); Quiebra Perol, *X. Cornejo & C. Bonifaz 7773* (GUAY, MO); cantón Muisne, San Salvador, orillas del río Sucio, *W. Palacios 13764* (MO, QCNE); cantón San Lorenzo, Reserva Indígena Awá, parroquia Ricaurte, comun. Balsareño, río Palabí, *D. Rubio & C. Quelal 1390* (MO, QCNE). **Manabí:** cantón Pedernales, Reserva Ecol. Mache-Chindul, comun. Ambacha, *J. L. Clark, R. Dunn, T. Núñez & C. Robles 4205* (MO, QCNE).

6. Posoqueria robusta Hammel & C. M. Taylor, sp. nov. TYPE: Costa Rica. Heredia: cantón de Sarapiquí, Llanura de San Carlos, Lomas Sardinal, ca. 15 km línea recta N de Puerto Viejo de Sarapiquí, 10°34′N, 84°03′W, 250–350 m, 12 Mar. 1994, *B. Hammel & M. Garita*

19531 (holotype, INB; isotypes, MO 04916434, MO 04916435). Figure 3A, B.

Haec species a *Posoqueria grandifructa* Hammel & C. M. Taylor foliis crassis, flore majore atque fructu subgloboso distinguitur.

Small to medium-sized trees flowering at 4.5 m tall, to 20 m tall; stems glabrous, perhaps somewhat succulent. *Leaves* with *blade* ovate, lanceolate-oblong, or lanceolate, 15–38.5 × 4–18 cm, apex acute to acuminate with tips to 1 cm, base obtuse to truncate or rounded, glabrous, drying stiffly chartaceous to subcoriaceous and often brittle, matte to somewhat shiny adaxially; secondary veins 5 to 8 pairs, prominulous to plane or sulcate adaxially, prominulous abaxially, the costa prominulous adaxially, prominent abaxially, the remaining veins plane and not visible on both surfaces; margins thinly revolute; *petiole* 10–25 mm, glabrous, often rather stout; *stipules* interpetiolar or shortly fused around stem, ligulate to ovate, 5–20 mm, acute to obtuse, glabrous, deciduous before leaves. *Inflorescences* terminal, cymose, 3–5 × 2–4.5 cm (not including corollas or fruits), puberulous to glabrous; bracts ovate to ligulate, 1–3 mm, obtuse to acute, ciliolate; pedicels 2–17 mm. *Flowers* with ovary portion cylindrical-ellipsoid, 3.5–4 mm, glabrous; *calyx* limb 2–3 mm, glabrous, subtruncate or lobed, lobes up to 1/2 of length of limb, broadly rounded, marginally nearly entire to irregularly ciliolate, sometimes hyaline; *corolla* in bud with lobes generally straight, at anthesis white, salverform, externally glabrous, tube 175–213 mm, 2–3 mm diam., granular-puberulous to sparsely hirtellous or pilose in throat and sometimes onto lobes, lobes 5, narrowly ligulate or lanceolate-oblong, obtuse to rounded, entire, the shortest lobe 30–40 mm, the longest lobe 35–50 mm; *stamens* with filaments 5–6 mm, equal or slightly unequal, inserted 6–7 mm below top of corolla tube, anthers narrowly ellipsoid, ca. 7 mm, partially included to just exserted, abaxially puberulous, at base and apex with triangular acute sterile portions ca. 1 mm; *stigmas* not seen. *Fruits* subglobose, ca. 6 × 6 cm, brown, outside smooth or slightly roughened; mesocarp woody, 4–5 mm thick; seeds broadly angled, ca. 1 cm.

Habitat, distribution, and phenology. *Posoqueria robusta* is known from wet forests at 10–400 m on the Caribbean slopes of Nicaragua and Costa Rica; it has been collected with flowers in January, March, May, September, and October, and with fruits in February, May, June, and September through November.

IUCN Red List category. *Posoqueria robusta* meets the geographic range criterion for Endangered based on its small EOO and its limited AOO. It is known from four governmentally protected areas as well as the La Selva Biological Station, a privately protected reserve. Although there is continuing decline in its habitat outside these protected areas, it is documented from what are here considered more than five but not more than 10 locations (i.e., areas subject to different kinds or degree of threat), and it is here considered Vulnerable due to habitat decline (VU B1ab[iii]+2ab[iii]).

Discussion. This new species is distinguished by its leathery, usually relatively large leaves with the venation mostly immersed in the tissues of the blade and not visible, except the secondary veins are prominent on the abaxial surface and plane or sometimes sulcate on the adaxial surface; its relatively large corollas; its anthers that are partly included to shortly exserted on filaments of generally equal length; and its generally subglobose, smooth or slightly roughened fruits with woody, rather thin walls. The specific epithet refers to the often rather large, leathery leaves and the relatively large flowers. This new species has previously been identified as *Posoqueria panamensis*; see the discussion in the introduction of the taxonomic problems with the circumscription of that species.

This new species is similar to *Posoqueria grandiflora*, but the latter can be recognized by its ellipsoid larger fruits (8–11 cm long), its longer corollas with the tube 260–360 mm long and the lobes deflexed in bud, its anthers fully exserted on flexuous filaments of unequal length, and its leaves that are sometimes glabrous but usually shortly pilosulose or velutinous throughout abaxially. On the Caribbean slopes of Costa Rica where these two species are locally sympatric (e.g., the La Selva Biological Station), they are easily separated by the abaxially glabrous leaves of *P. robusta* versus the leaves clearly pubescent below in *P. grandiflora*. On the Pacific slopes of Costa Rica, *P. grandiflora* has leaves that are glabrous abaxially, but *P. robusta* has not been found in that region.

Paratypes. COSTA RICA. **Alajuela:** cantón de San Carlos, Parcela Pipasa, *D. Solano & N. Zamora 2774* (INB). **Heredia:** cantón de Sarapiquí, Parque Nac. Braulio Carrillo, Est. El Ceibo, *R. Aguilar 16* (CR, MO), *B. Boyle 3756* (INB), *J. González 3182* (INB); Est. Magsaysay [Magsasay], *C. Alvarado 77* (INB), *A. Fernández 88* (INB, MO), *L. D. Vargas, A. Rodríguez & E. Ureña 38* (INB, MO); La Selva Protection Zone, Guácimo Ridge Trail, *G. S. Hartshorn 2552* (MO); ca. 8 km SW of Puerto Viejo de Sarapiquí along [old] rd. to San José, *W. Burger & G. Matta U. [G. Mata U.] 4275* (DUKE, F, MO); Finca La Selva, OTS biol. station at jct. of Ríos Sarapiquí & Puerto Viejo, *J. Folsom 9172* (DUKE, MO), *9632* (DUKE, MO), *M. Grayum 2528* (DUKE), *B. Jacobs 3008* (DUKE), *T. McDowell 726*

(DUKE), *D. Smith 460* (DUKE); Chilamate de Sarapiquí, S base of Cerros Sardinal, Finca El Bejuco, *M. H. Grayum & B. Jacobs 5324* (MO), *D. A. Smith & G. Schatz 1214* (DUKE, MO); Bijagual, camino a Magsaysay [Magsasay], *Q. Jiménez, B. Hammel, R. Rueda, E. Lépiz & V. Ramírez 1445* (INB, MO), *V. Ramírez, Q. Jiménez & B. Hammel 216* (INB, MO); Lomas Sardinal, N de Puerto Viejo, *B. Hammel 20670* (INB), *B. Hammel, A. Rodríguez & V. Ramírez 21198* (INB). **Limón:** cantón de Pococí, Llanura de Tortuguero, El Cedral, 26 km N of Cariari, *K. Thomsen 1180* (C, MO); Cariari, Palmitas, El Triángulo, Las Brisas, *Q. Jiménez, A. Estrada & L. D. Vargas 2099* (INB, MO). NICARAGUA. **Río San Juan:** 1.5 km W (above) & 0.5 km N of Delta, *R. Riviere 328* (MO); mpio. San Juan del Norte, Res. Indio-Maíz, Cerro el Gigante, *R. Rueda, I. Coronado & N. Tercero 444* (HULE, MO); Cerro el Diablo, *R. Rueda, I. Coronado, O. Aráuz & F. Flores 5434* (HULE, MO); Cerro Canta Gallo, *R. Rueda, I. Coronado, W. Velásquez & Y. Rui 8594* (HULE, MO).

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Abstract. The Neotropical genus *Borojoa* Cuatrec. (Rubiaceae) is now considered a synonym of *Alibertia* A. Rich. ex DC. Consequently, three species named in *Borojoa* and found in Costa Rica and Panama are transferred to *Alibertia* with these corresponding nomenclatural changes: the new combination *A. atlantica* (Dwyer) Delprete & C. H. Perss. is based on *B. atlantica* Dwyer, the new name *A. dwyeri* Delprete & C. H. Perss. is provided for *B. panamensis* Dwyer, and the new combination *A. patinoi* (Cuatrec.) Delprete & C. H. Perss. is provided for *B. patinoi* Cuatrec. Additionally, the species *A. premontana* C. M. Taylor is reduced to a variety of *A. edulis* (Rich.) A. Rich. ex DC., as *A. edulis* var. *premontana* (C. M. Taylor) Delprete & C. H. Perss. A lectotype is selected for *A. edulis*. The recent publication of *Arachnothryx chimalaparum* Lorence ex Borhidi designated a holotype deposited at MO, but no such specimen has been located; a lectotype is here chosen based on a duplicate of the holotype deposited at MEXU. The new species *Notopleura recondita* Hammel & C. M. Taylor of the Osa Peninsula of Costa Rica can be distinguished from *N. polyphlebia* (Donn. Sm.) C. M. Taylor by its leaf blades with the secondary veins plane on the adaxial surface and its short cymose or paniculiform inflorescences. The new species *Palicourea matamana* C. M. Taylor of premontane forests of central-eastern Costa Rica can be separated from *P. orosiana* C. M. Taylor by its larger stipules, longer calyx lobes, and hirsute pubescence. The new species *P. providenciana* J. Sánchez-Gonz. & C. M. Taylor of

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montane forests in south-central Costa Rica can be separated from *P. hammelii* C. M. Taylor by its longer lanceolate stipule lobes, dark purple or yellow-flushed inflorescences, and shorter calyx lobes. The Panamanian plants treated previously as *Psychotria acuminata* subsp. *boraginoides* Dwyer are here considered to differ at the species level from *P. acuminata* Benth., and accordingly the new combination *P. boraginoides* (Dwyer) C. M. Taylor is here published for this species. Clarification of the identity of *Cephaelis croatii* Dwyer shows that it is a distinct species of *Psychotria*, and the new combination *P. croatii* (Dwyer) C. M. Taylor is published here for this species. The new species *P. herrerana* C. M. Taylor of central Costa Rica can be recognized by its combination of large, sessile, elliptic leaves, its large paniculiform inflorescences, and its relatively small corollas. Study of the Costa Rican plants previously called *Rudgea thyrsiflora* Donn. Sm. shows that these do not have the characters of *Rudgea*, but are similar to *Psychotria racemosa* Rich. and better included in this latter genus; the new name *P. tsakiana* C. M. Taylor is here published for this species. The new combination *Simira panamensis* (Dwyer) C. M. Taylor is published here based on the name *Bathysa panamensis* Dwyer, which has priority over the name *S. darienensis* Dwyer; both of the names Dwyer published are based on the same type specimen, thus the later name *S. darienensis* is illegitimate.

Resumen. El género neotropical *Borojoa* Cuatrec. (Rubiaceae) ahora se considera un sinónimo de *Alibertia* A. Rich. ex DC., por lo tanto las tres especies con nombres en *Borojoa* que se encuentran en Costa Rica y Panama se transfieren a *Alibertia* con los cambios nomenclaturales correspondientes: la combinación nueva *A. atlantica* (Dwyer) Delprete & C. H. Perss. se basa en *B. atlantica* Dwyer, el nombre nuevo *A. dwyeri* Delprete & C. H. Perss. se publica para *B. panamensis* Dwyer, y la nueva combinación *A. patinoi* (Cuatrec.) Delprete & C. H. Perss. se publica para *B. patinoi* Cuatrec. Además la especie *A. premontana* C. M. Taylor se rebaja a una variedad de *A. edulis* (Rich.) A. Rich. ex DC., con el nombre *A. edulis* var. *premontana* (C. M. Taylor) Delprete & C. H. Perss. Se escoge un lectotipo para *A. edulis*. Para la especie recientemente descrita *Arachnothryx chimalaparum* Lorence ex Borhidi designó un holotipo depositado en MO, pero tal espécimen no se ha ubicado; aquí se escoge como lectotipo un duplicado del holotipo en MEXU. La especie nueva *Notopleura recondita* Hammel & C. M. Taylor de la Península de Osa de Costa Rica se distingue de *N. polyphlebia* (Donn. Sm.) C. M. Taylor por las láminas foliares con las venas secundarias planas en el haz y las cortas inflorescencias cimosas o paniculiformes. La especie nueva *Palicourea matamana* C. M. Taylor de bosques premontanos del centro-este de Costa Rica se distingue de *P. orosiana* C. M. Taylor por las estípulas más grandes, los lóbulos del cáliz más largos y la pubescencia hirsuta. La especie nueva *P. providenciana* J. Sánchez-Gonz. & C. M. Taylor de bosques montanos en el sur-central de Costa Rica se distingue de *P. hammelii* C. M. Taylor por los lóbulos de las estípulas lanceolados y más largos, las inflorescencias de color morado oscuro o matizado con amarillo y los lóbulos del cáliz más cortos. Las plantas panameñas anteriormente tratadas en *Psychotria acuminata* subsp. *boraginoides* Dwyer aquí se consideran diferentes de *P. acuminata* Benth. al nivel de especie, entonces la combinación nueva *P. boraginoides* (Dwyer) C. M. Taylor se publica aquí para esta especie. La clarificación de la identidad de *Cephaelis croatii* Dwyer demuestra que es una especie diferente de *Psychotria*, y la combinación nueva *P. croatii* (Dwyer) C. M. Taylor se publica aquí para esta especie. La especie nueva *P. herrerana* C. M. Taylor del centro de Costa Rica se reconoce por la combinación de las hojas grandes, sésiles y elípticas, las grandes inflorescencias paniculiformes y las corolas relativamente pequeñas. El estudio de las plantas costarricenses anteriormente llamadas *Rudgea thyrsiflora* Donn. Sm. demuestra que éstas no tienen los carácteres de *Rudgea* y son similares a *Psychotria racemosa* Rich., entonces se incluyen mejor in este segundo género; el nombre nuevo *P. tsakiana* C. M. Taylor se publica aquí para esta especie. La combinación nueva *Simira panamensis* (Dwyer) C. M. Taylor se publica aquí basado en el nombre *Bathysa panamensis* Dwyer, lo cual tiene prioridad sobre el nombre *S. darienensis* Dwyer; ambos de los nombres publicados por Dwyer se basan en el mismo espécimen tipo, entonces el nombre posterior *S. darienensis* es ilegítimo.

Key words: *Alibertia*, *Arachnothryx*, *Bathysa*, *Borojoa*, *Cephaelis*, Colombia, Costa Rica, Gardenieae, IUCN Red List, Mexico, Neotropical floristics, *Notopleura*, *Palicourea*, Palicoureeae, Panama, *Psychotria*, Psychotrieae, Rubiaceae, *Rudgea*, *Simira*.

Recent botanical exploration in southern Central America has added significantly to our knowledge of the flora of this region. Here we describe several new species and publish several taxonomic changes for the Rubiaceae of this region, in preparation for the upcoming publication of the Rubiaceae treatments for the Flora Mesoamericana and the Manual de Plantas de Costa Rica projects.

Methods

The genera and species studied here are arranged in alphabetical order. Authorship of sections on individual genera here varies and is indicated for each section. Additional collection data for most of the specimens cited here are available at <http://www.tropicos.org>, along with high-resolution digital images of the type specimens of the newly described species.

Conservation status assessment methodology. The study presented here is taxonomic and floristic: the objective is enumeration of the species that belong to various Rubiaceae genera, and of the species that occur in the area of tropical Central and South America. The methods employed here correspond only to this objective; thus this study is based on survey of specimens collected over a number of years using varied survey methods aimed at various objectives. The specimens here used to delineate the range and commonness of these new species were located through a nonexhaustive survey of several herbaria, and no field studies have been done targeting the occurrence of these species where they are known or expected to grow. Thus the floristic information presented here is a simplified presence report based on incomplete survey of the available data, which are uneven and incomplete for this region (Schulman et al., 2007). Knowledge of the true geographic range and the population size and dynamics of a species are essential to understanding the threats to its existence, and thus to understanding its actual conservation status; documentation of the existence of a species based on one or several museum collections does not provide adequate data to evaluate these factors. Conservation assessments are provided here for these newly described species using IUCN categories and criteria (IUCN, 2001) based on the totality of our current knowledge. The basis for these assessments in the form of a map and the calculated assessment parameters are available under the corresponding species names at <http://www.tropicos.org>. The assessment parameters were calculated using the IUCN Rating tool (Moat, 2007) in ArcView GIS 3.2 (ESRI, 1999), with the grid cell size used for calculating Area of Occupancy (AOO) varied between 1 and 3.16 km depending on characteristics of the species and data (IUCN Standards and Petitions Working Group, 2008). These assessments are not being submitted to IUCN for publication on the Red List (<http://www.iucnredlist.org>), and the basis for these assessments should be carefully evaluated by the reader.

Taxonomy

New combinations and a new name in *Alibertia**

Cuatrecasas (1953) and Steyermark (1966) distinguished *Borojoa* Cuatrec. from *Alibertia* A. Rich. ex DC. by having entirely fleshy fruit, heteromorphous flowers with a thicker corolla, flowers subtended by two stipulelike bracts, and stipules partially connate at the base. However, detailed study of the group revealed that the three latter characters also occur in *Alibertia*, and that several *Borojoa* species, as well as many *Alibertia* species, also have a woody mesocarp. In a phylogenetic analysis using nuclear ribosomal DNA sequences of the ITS and 5S regions, the genus *Borojoa* appeared nested inside *Alibertia* s. str. (Persson, 2000), which consequently becomes paraphyletic if *Borojoa* is treated separately. Therefore, from the evidence presented, it is concluded that *Borojoa* is better included within *Alibertia*. For the forthcoming account of Rubiaceae for the *Flora Mesoamericana*, two new combinations and one new name are here proposed. In addition, *A. premontana* C. M. Taylor is here lowered to a variety of *A. edulis* (Rich.) A. Rich. ex DC., as the original differentiating characters are not complete when considering the species over its entire distribution range.

1. **Alibertia atlantica** (Dwyer) Delprete & C. H. Perss., comb. nov. Basionym: *Borojoa atlantica* Dwyer, Ann. Missouri Bot. Gard. 67: 46. 1980. TYPE: Panama. Colón: 2–3 mi. up Río Guanche, 10–20 m, 19 Jan. 1973 (fr.), *H. Kennedy & R. Foster 2197* (lectotype, designated by Lorence [1999: 19], MO 2163702 [sheet 2 of 2]; isotypes, F, MO 2163702 [sheet 1 of 2], PMA not seen).

Discussion. The two sheets of *Kennedy & Foster 2197* at MO have the same sheet accession number, MO 2163702, and apparently Dwyer (1980) had intended both sheets to comprise the holotype, although this is not noted in his protologue. However, the two sheets are similar and not complementary, as each consists of two leaf pairs and a single sectioned fruit. Because of this ambiguity, sheet 2 of 2 was selected by Lorence (1999) as holotype because it is

*This section authored by Piero G. Delprete and Claes Persson.

slightly more complete and representative, with a fruit cut into three sections and a portion of stem bearing two well-spaced leaf pairs. Lorence's designation is here considered effective lectotypification.

Alibertia atlantica is a small to medium-sized tree, distributed from Nicaragua to Panama, and characterized by leaf blades with (nine to)11(or 12) pairs of secondary veins and fruits with a woody mesocarp. It is closely related to *A. dwyeri* Delprete & C. H. Perss. (see below), but distinguished by its relatively short petioles ([5–]10–18 mm long vs. [5–]10–27 mm), persistent elliptic stipules with an acute apex (vs. subcaducous, slightly obovate to obovate, rarely elliptic, with an acuminate apex), and leaf blades that usually dry dark brown (vs. drying brown to brownish olive-green). In addition, *A. atlantica* seems to occur in lowland forests, below 400 m, whereas *A. dwyeri* seems to prefer cloud forests at 600–900 m altitude.

The type of *Alibertia atlantica* belongs to a somewhat isolated population in central Panama and differs morphologically from the Costa Rican populations in its olive-green leaf blades when dry and its sparsely puberulent fruits.

Selected specimens examined. COSTA RICA. **Heredia:** Puerto Viejo de Sarapiquí, Finca Tropical, *Beach 1488* (MO). NICARAGUA. **Río San Juan:** Reserva Indio-Maiz, Mpio. Juan del Norte, Cerro el Gigante del Río San Juan, 10°46′N, 83°53′W, 100 200 m, *R. Rueda et al. 8871* (MO). PANAMA. **Colón**: Río Guanche, ca. 2 km upstream from bridge, *Kennedy et al. 3411* (US).

2. Alibertia dwyeri Delprete & C. H. Perss., nom. nov. Replaced synonym: *Borojoa panamensis* Dwyer, Phytologia 17: 446. 1968, non *Alibertia panamensis* L. Riley, Bull. Misc. Inform. Kew 1927: 123 [—*Alibertia edulis* (Rich.) A. Rich. ex DC., Prod. (DC.): 4: 443. 1830.]. TYPE: Panama. Coclé: Cerro Pilon [Pilón], El Valle, 4 Jan. 1968 (fr.), *J. A. Duke & B. R. Lallathin 15014* (holotype, MO 1968459; isotype, MO 2163702).

Discussion. In the original description, the isotype was cited as an additional specimen. The information on the original label of the isotype is scanty and includes only that the specimen was collected at Cerro Pilón at 2700 ft. [ca. 823 m] by B. R. Lallathin in 1968, coll. no. 15014. According to an additional label added by C. M. Taylor, the original label was probably mistyped, as the digit "1" seems to be added afterward in front of "5014." Also, the elevation note "2700 ft." is lacking on the holotype. The label of the holotype also gives the following information: "Tree fruits green; probably edible when ripe. Fruit, when sawed into, blackening as if possessed of genipine." The protologue reads that the holotype was collected by Duke and Dwyer, an error that was corrected by Dwyer (1980) in his treatment of Rubiaceae for the *Flora of Panama*. The specific epithet is dedicated to John D. Dwyer (1915–2005), specialist in Neotropical Rubiaceae (and who first described this species). Dr. Dwyer worked for more than 30 years at St. Louis University and the Missouri Botanical Garden, and realized more than 30 expeditions to remote areas of Belize, Guatemala, and Panama (for his biography, see Croat et al., 2006).

Alibertia dwyeri is a common tree in the understory of cloud forests of Panama, at 600–900 m altitude. It is similar to *A. utleyorum* (Dwyer) C. M. Taylor in having acuminate stipules and elliptic to broadly elliptic or slightly obovate leaf blades, but differs by the leaf blades being glabrous or sometimes minutely puberulent on the midvein and secondary veins abaxially (vs. velutinous or hirsutulous abaxially), the glabrous fruits (vs. densely velutinous-puberulent or glabrate), and the dentate or jagged calyx margin (vs. distinctly lobate). For a comparison with *A. atlantica*, see above.

Selected specimens examined. PANAMA. **Coclé:** Along rd. betw. Llano Grande & Coclesito, N of Pintada, 6 km N of Llano Grande, 600 m, *Antonio 3605* (MO); Cerro Pilón, *Dwyer 8341* (MO). **Panamá:** Cerro Campana above Su Lin Motel, *Croat 14779* (F, MO, NY).

3. Alibertia edulis (Rich.) A. Rich. ex DC., Prod. (DC.) 4: 443. 1830. Basionym: *Genipa edulis* Rich., Actes Soc. Hist. Nat. Paris 1: 107. 1792. TYPE: Guyane Françoise [French Guiana]. S. loc., 1792, *Le Blond s.n.* (lectotype, designated here, P).

Discussion. Lorence (1999) indicated that the type of this taxon was collected by L. C. Richard. However, based on additional evidence it is apparent that the type material was instead collected by Le Blond in French Guiana and described shortly after by Louis Claude Richard. As L. C. Richard was in French Guiana after the publication of *Genipa edulis* Rich., it is impossible that he collected the type material. There is a sheet at the P herbarium that corresponds entirely to this, and it is here selected as lectotype in accordance with the *International Code of Botanical Nomenclature* (McNeill et al., 2006: Art. 9.9).

3a. Alibertia edulis var. **edulis**.

Selected specimens examined. NORTH AMERICA. MEXICO. **Chiapas:** Mun. Arriaga, 6 km N of Arriaga, 250 m, *Breedlove 27291* (NY).

CENTRAL AMERICA. BELIZE. **Dist. Toledo:** Punta Gorda, near Manuel Sam's house, 16°08′N, 88°53′W, 200 m, *Cordero et al. 22* (NY). COSTA RICA. Reserva Forestal de San Ramón, 10°12′53″, 84°36′28″W, 800–1000 m, *Herrera & Mora 195* (MO). **Guanacaste:** Guanacaste mtn. range, Maritza station, slopes of Volcano Orosi, 10°57′40″N, 85°29′40″W, 600 m, *Ramirez et al. 47* (GB). EL SALVADOR. **Chalatenango:** vic. San Ignacio, 3000 ft. [914 m], *Allen 7043* (F, NY). **Morazán:** Río Sapo, 13°55′66″N, 88°5′86″W, 670 m, *Monro et al. 2807* (PTBG). GUATEMALA. **Izabal:** Ensenda Los Lagartos, 1 m, *Stevens et al. 25320* (MO). HONDURAS. **Francisco Morazán:** Jicarito River, drainage of Río Yeguare, 14°N, 87°W, 800 m, *Glassman 1721* (F, NY). NICARAGUA. **Chinandega:** 3–4 km SE of San Pedro de Potrero Grande, Los Laureles, 13°15′N, 86°53′W, 340–400 m, 28 Sep. 1981 (fr.), *Moreno 11701* (NY). PANAMA. **Panamá:** Cerro Colorado, rd. to Bocas del Toro, end of mtn. access rd. just above face of mine, 1600–1700 m, *Folsom et al. 4740* (MO).

SOUTH AMERICA. BOLIVIA. **Beni:** Ballivián, Serranía Pilon Lajas, 24 km SO of Yucumo, on rd. Yucumo-Quiquibe, 15°15′S, 67°00′W, 850–900 m, *Killeen et al. 2981* (MO). BRAZIL. **Chapada do Veadeiros [Goias]:** Mun. Alto Paraiso, ca. 25 km N of Alto Paraiso, 1700 m, *Anderson et al. 6689* (NY).

3b. Alibertia edulis var. **premontana** (C. M. Taylor) Delprete & C. H. Perss., comb. et stat. nov. Basionym: *Alibertia premontana* C. M. Taylor, Novon 6: 215, fig. 1. 1996. TYPE: Costa Rica. Alajuela: Reserva Biol. Monteverde, Valle del Río Peñas Blancas, fila del Toro, Sendero Pipilacha y Campo Tres, 10°N, 84°W, 900–1100 m, 21 Jan. 1991 (fr.), *W. Haber & E. Cruz 10630* (holotype, MO 4234216; isotypes, CR not seen, F, INB).

Discussion. *Alibertia edulis* var. *premontana* differs primarily from variety *edulis* by its leaf blades that are matte adaxially and glabrous abaxially (vs. usually glossy adaxially and glabrous or puberulent abaxially) and its short stipules (4–7[–11] mm long vs. 5–15[–22] mm long). *Alibertia edulis* var. *premontana* occurs in wet premontane forests at 800–1700 m, whereas variety *edulis* normally occurs below 500 m, but may reach 1000 m in Costa Rica and Panama, and up to 1700 m in central Brazil.

Selected specimens examined. COSTA RICA. **Puntarenas:** Bosque Eterno de Los Niños, Río Peñas Blancas, Quebrada Gata, Riachuelo de Fernando Villalobos, 10°23′N, 84°42′W, 1100 m, *Bello et al. 2172* (F, INB, MO); Cantón Parrita, Cuenca del Pirris-Damas, cabeceras Río Palo Seco, camino a Fila Chonta, 09°35′N, 84°09′W, 1050–1300 m, *Morales & Rodríguez 6453* (INB). **San José:** Turrubares, mtn. slope of Cerro Bares, 09°47′N, 84°28′W, 1550 m, *Jiménez et al. 836* (INB [2], MO). PANAMA. **Bocas del Toro:** Chiriquí-Bocas del Toro border, vic. Cerro Colorado, along mining rd. on divide, 08°35′N, 81°50′W, 1300–1400 m, *McPherson 13644* (MO). **Chiriquí/Bocas del Toro border:** Cerro Colorado, rd. to Bocas del Toro, end of mtn. access rd. just above face of mine, 1600–1700 m, *Folsom et al. 4740* (MO), *4743* (MO). **Chiriquí:** Fortuna Dam, 1400–1600 m, *Folsom et al. 5606* (MO); Valley of El Hornito, vic. Fortuna Dam, along trail down from hwy., 08°45′N, 82°15′W, 1100–1300 m, *McPherson 12525* (MO).

4. Alibertia patinoi (Cuatrec.) Delprete & C. H. Perss., comb. nov. Basionym: *Borojoa patinoi* Cuatrec., Secr. Agric. Ganad. Colomb. Serv. Divulg. Ser. Bot. Aplic. 2: 474 1949 [preprint of Rev. Acad. Colombia Ci. Exact. 7: 474. 1950]. TYPE: Colombia. El Valle: Río Calima (región de Chocó), rt. margin betw. Quebrada de la Brea & La Esperanza, 25 m, 19 May 1946, *J. Cuatrecasas 21137* (holotype, F 1251558; isotypes, F [3], US).

Discussion. *Alibertia patinoi* is a shrub, treelet, or tree with a natural distribution ranging from Costa Rica through Panama, along the Pacific coast of the Chocó Region of Colombia to the province of Esmeraldas, Ecuador. It is often cultivated in the Chocó Region for its large, edible fruits (locally called borojó) and occasionally also in the Amazonian region of Colombia and Ecuador. This species is characterized by its large stipules ([19–]25–35[–45] mm long), glabrous leaves with (9 to)12 to 17 pairs of secondary veins, 5- or 6(7)-merous male flowers, 7- to 9-merous female flowers, stout corollas, and large fruits with a thick, fleshy mesocarp.

Selected specimens examined. CENTRAL AMERICA. COSTA RICA. **Puntarenas:** Osa Peninsula, Cantón Golfito, Parque Nac. Corcovado, Est. Los Patos, Sendero Sirena, 08°43′N, 83°3′W, 200 m, *Aguilar 3315* (F[2], INB, NY). PANAMA. **Darién:** Santa Fé, *Bristan 310* (MO).

SOUTH AMERICA. COLOMBIA. **Chocó:** Mun. Riosucio, Zona de Urabá, Cerros de Cuchillo, Piedmont de Cerro, 100 m, *Cárdenas 1867* (MO). ECUADOR. **Esmeraldas:** Cantón San Lorenzo, La Chiquita Exp. For. Station, 01°38′N, 78°45′W, *Persson & Nordenhäll 429* (GB, QCNE).

ARACHNOTHRYX PLANCH.: LECTOTYPIFICATION OF THE NAME *ARACHNOTHRYX CHIMALAPARUM**

In his publication on the Rubiaceae of Mexico, Borhidi (2006: 45, 479) described the new species

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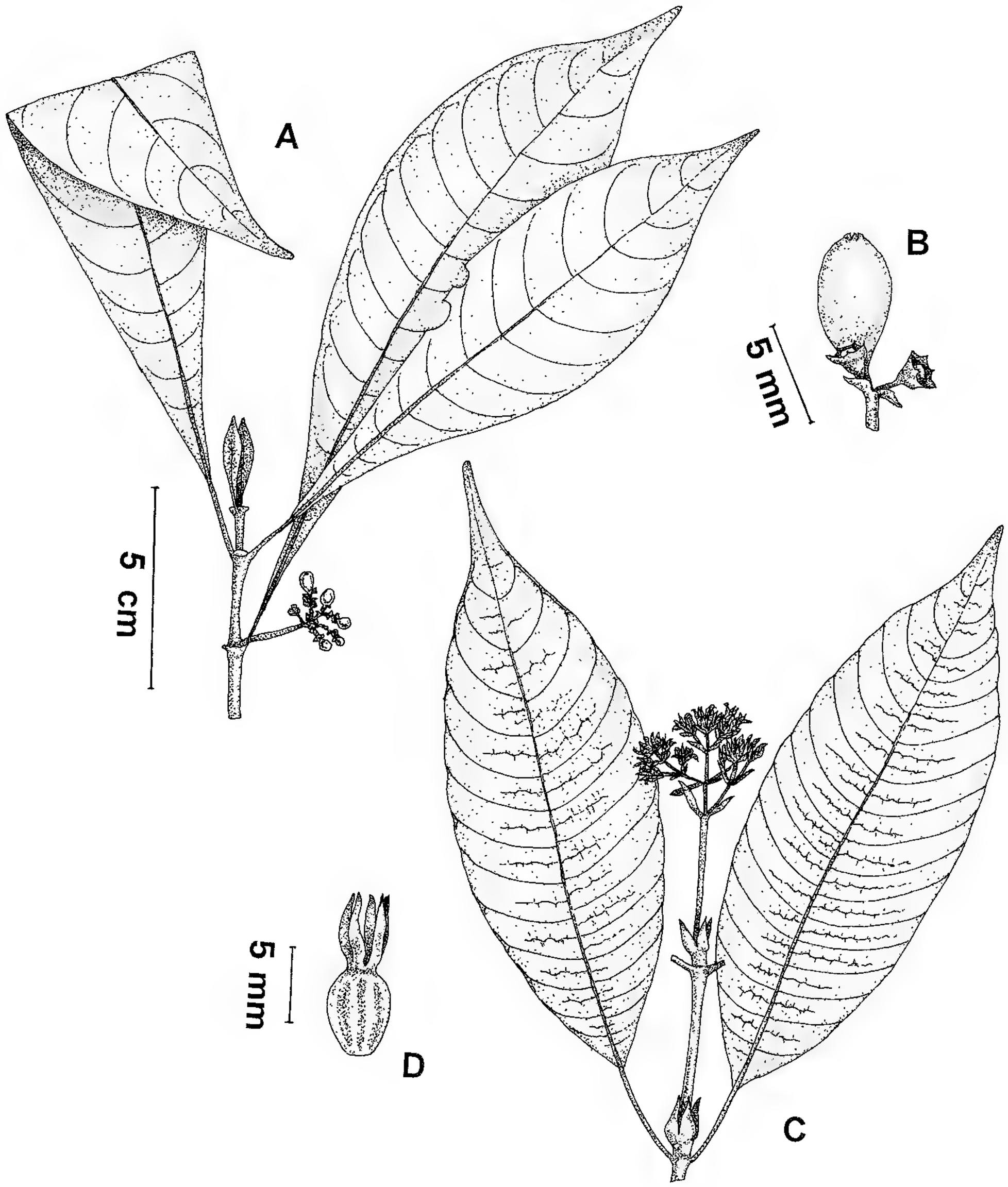

Figure 1. A, B. *Notopleura recondita* Hammel & C. M. Taylor; based on the paratype *Hammel 18287* (F). —A. Portion of branch with infructescence with young fruits. —B. Portion of infructescence with one developing fruit and two flowers from which corollas have fallen. C, D. *Palicourea providenciana* J. Sánchez-Gonz. & C. M. Taylor. —C. Portion of branch with old inflorescence; based on the paratype *Rodríguez et al. 8154* (INB). —D. Fruit; based on the paratype *Martén & Herrera 709* (F). A, C drawn to same scale, indicated as 5 cm.

Arachnothryx chimalaparum Lorence ex Borhidi based on the following specimen: "Mexico, Oaxaca, municipio de Santa María Chimalapa, Cerro de la Fortuna, *Wendt et al. 5676*." Borhidi apparently assumed that the specimen he designated as holotype was deposited at MO, stating in the protologue "holotipo: MO, isotipo: MEXU," but extensive searching by Taylor and Lorence at MO has failed to locate the specimen, suggesting that a duplicate was not sent to MO. According to the ICBN (McNeill et al., 2006: Art. 9.9), if the holotype is lost or destroyed, a lectotype should be designated. The cited isotype collection was located at MEXU and was seen by Borhidi. A digital image of this specimen was seen by Lorence. Wendt's collections were distributed from the Colegio de Postgraduados, Montecillos at Chapingo, Mexico, from the CHAPA herbarium where a duplicate also exists. Another

duplicate of this collection has been located at TEX, and a fourth duplicate of this collection was sent to Lorence for identification and is deposited in the herbarium of the National Tropical Botanical Garden (PTBG). The specimen at MEXU is here designated as the lectotype of *A. chimalaparum*, and the PTBG, CHAPA, and TEX specimens are designated as isotypes.

Arachnothryx chimalaparum Lorence ex Borhidi, Rubiáceas México 45. 2006. TYPE: Mexico. Oaxaca: mun. Santa María Chimalapa, Cerro de la Fortuna, un cerro de 1000 m en el SO de la Sa. Tres Picos, 17°1′30″N, 94°37′O, 1000 m, 28 Abr. 1987, *T. Wendt, H. Hernández G., C. González L. & C. Hernández G. 5676* (lectotype, designated here, MEXU 582265; isotypes, CHAPA, PTBG 013786, TEX).

NOTOPLEURA: A NEW SPECIES FROM COSTA RICA*

Notopleura (Oerst.) Bremek. comprises about 100 species of rather succulent, generally suffrutescent herbs and epiphytes found in wet tropical forests from Mexico and the Antilles to Bolivia and eastern Brazil. It was included by many authors in *Psychotria* L., but now appears more closely related to *Palicourea* Aubl.; *Palicourea* and related genera, including *Notopleura*, have sometimes been classified in a separate tribe from *Psychotria*, the Palicoureeae (Robbrecht & Manen, 2006), though other authors have provisionally placed these all together until the entire group is better understood (Bremer & Eriksson, 2009). The terrestrial species of *Notopleura* differ from *Psychotria* in their generally unbranched habit, succulent usually glandular stipules, and pseudoaxillary inflorescences (Taylor, 2001). *Notopleura* has a center of diversity in southern Central America, with more than a third of its species found in that region (Taylor, 2003); 24 species of *Notopleura* are known from Costa Rica, including the one newly described here. The description format and terminology here follow Taylor (2001, 2003). Keys to the species of *Notopleura* in Mesoamerica and Costa Rica will be presented in the forthcoming Rubiaceae treatments for the Flora Mesoamericana and Manual de Plantas de Costa Rica projects, respectively.

Notopleura recondita Hammel & C. M. Taylor, sp. nov. TYPE: Costa Rica. Puntarenas: cantón de Osa, Reserva Forestal de Golfo Dulce, fila entre Rancho Quemado & Drake, bosque alto a la par de camino, 8°42′N, 83°36′W, 350 m, 4 July 2003, *B. Hammel, I. Pérez & J. Salazar 22841* (holotype, INB; isotypes, CR, USJ). Figure 1A, B.

Haec species a *Notopleura polyphlebia* (Donn. Sm.) C. M. Taylor foliorum venis secundariis adaxialiter laevibus atque inflorescentia ramosa distinguitur.

Succulent, erect, terrestrial herbs or soft shrubs to 0.5 m tall, rhizomatous; stems unbranched, glabrous. *Leaves* oblanceolate to elliptic, 10.5–25.5 × 2–5.8 cm, apex acuminate, base acute to cuneate, drying papyraceous, adaxially glabrous and with darkened velvety appearance, abaxially puberulous to glabrescent and pale; costa prominulous adaxially, prominent abaxially; secondary veins 8 to 15 pairs, free or usually looping weakly to interconnect, adaxially plane, abaxially prominulous, with remaining venation plane and not visible on both surfaces; *petioles* 1–3 cm, puberulous to glabrescent; *stipules* glabrous, sheath 1–1.5 mm, broadly rounded, deciduous, with 1 interpetiolar appendage inserted near base, broadly triangular, 1.5–2 mm, succulent, flattened, acute to shortly erose, perhaps glandular, deciduous with or before sheath. *Inflorescence* pseudoaxillary, shortly paniculiform or cymose, apparently green, densely puberulous or hirtellous, ascending to spreading; peduncle 0.3–1.2 cm; branched portion corymbiform to pyramidal, 0.5–2 × 0.5–2 cm, with secondary axes developed at 1 to 2 nodes, 2 per node, ascending, branched to 1 to 2 orders, dichasial; bracts triangular to linear, entire, those subtending secondary axes 2–3 mm, those subtending flowers 0.8–1 mm. *Flowers* sessile and subsessile in glomerules of 2 to 5 at ends of axes; ovary obconic, ca. 0.5 mm, glabrescent; *calyx* limb 0.5–1 mm, densely puberulous, 5-lobed for 1/2–3/4, lobes narrowly triangular; *corolla* in bud densely puberulous externally, with lobes 5, smooth abaxially; stamens, style, and stigmas not seen. *Infructescences* similar to inflorescences. Immature *fruits* ellipsoid, ca. 6 × 5 mm, glabrescent, green becoming orange; pyrenes 2, flattened, dorsally with 3 to 4 low sharp subequal longitudinal ridges and margins thickened.

Habitat, distribution, and phenology. Notopleura recondita is known from wet forests at 180–350 m on the Osa Peninsula in southern Costa Rica; it has been collected with flower buds in February, and with immature fruits in July and September.

IUCN Red List category. Notopleura recondita meets the criterion for Endangered based on its limited AOO and no more than five locations; because there are only two collecting localities, the Extent of Occurrence (EOO) cannot be calculated.

*This section authored by Barry Hammel, Charlotte M. Taylor, and Roy E. Gereau.

This species is found entirely within one legally protected area, and overall is known from a small geographic region. It may be more common here than documented by specimens, as discussed in the comments below, because this species is easily overlooked. The habitats of this species are generally not in decline at the moment; therefore, it is assessed as Vulnerable due to its small range (VU D2). However, if the habitats of its range do begin to decline, then this species will become Endangered.

Discussion. This new species is distinguished within *Notopleura* by the combination of its terrestrial habit with the stems unbranched, its relatively small cymose or paniculiform inflorescences with the flowers grouped at the ends of the axes, and its flattened pyrenes with several low longitudinal ridges on the dorsal (i.e., abaxial) surface. *Notopleura recondita* belongs to *Notopleura* subg. *Notopleura*, which comprises the terrestrial *Notopleura* species with an unbranched habit (Taylor, 2001). This new species is only known from the Osa Peninsula in the Golfo Dulce region, an area of some endemism in Costa Rica, but also with phytogeographic relationships to lower and middle elevations of the eastern or Caribbean slopes of Costa Rica. These small understory plants are rare, even locally, and shade-loving with very dark green, matte leaves and the reproductive structures rather small and nondescript. Thus hidden, this species is easily overlooked and has been rarely collected, hence the specific epithet.

The fruits seen are apparently immature, based on their size and nonsucculent form, and the orange color reported for them may not be their color at maturity. Several species of this genus (e.g., *Notopleura uliginosa* (Sw.) Bremek., *N. polyphlebia* (Donn. Sm.) C. M. Taylor) have orange immature fruits that ultimately become black at maturity, though those mature fruits are rarely seen because the frugivores remove them very quickly after they change color; *N. recondita* may share this biology.

Due to its apparently axillary inflorescences and small stature, *Notopleura recondita* can be confused with *Ronabea emetica* (L. f.) A. Rich., which differs in its truly axillary inflorescences, i.e., present in both axils at each node, and blue to black fruits (Taylor, 2004). In its low, rhizomatous growth form, dark green velvety leaf surface, and orange immature fruits, *N. recondita* is similar to *N. polyphlebia*; however, *N. polyphlebia* can be recognized by its capitate inflorescences and oblong-obovate leaves that are deeply plicate along the secondary veins, which are thinly prominent on the adaxial surface.

Paratypes. COSTA RICA. **Puntarenas:** cantón Osa, Reserva Forestal de Golfo Dulce, en el S del valle de Rancho Quemado, ca. 15 km O de Rincón, *B. Hammel, H. Kennedy & J. Solomon 17865* (CR, F, MO), *B. Hammel, M. M. Chavarría, P. Maas & H. Maas 18067* (CR, F, MO), camino nuevo entre Rancho Quemado & Drake, *B. Hammel 18287* (CR, F, INB, MO).

PALICOUREA: TWO NEW SPECIES FROM COSTA RICA*

Palicourea (Palicoureeae) comprises about 250 species of shrubs and small trees found in wet tropical forests from Mexico and the Antilles to Bolivia and northern Argentina (Taylor, 1997). *Palicourea* has long been considered closely related to *Psychotria*, but *Palicourea* differs from *Psychotria* in its persistent stipules and blue to black fruits. *Palicourea* has been recently classified in a separate tribe from *Psychotria*, Palicoureeae (Robbrecht & Manen, 2006), though other authors have provisionally placed these all together until the entire group is better understood (Bremer & Eriksson, 2009). *Palicourea* has a center of diversity in the premontane and montane habitats of southern Central America, with more than a fourth of its species found here; 44 species of *Palicourea* are known from Costa Rica, including the two species newly described in this article. The description format and terminology used here generally follow Taylor (1997). Keys to the species of *Palicourea* in Mesoamerica and Costa Rica will be presented in the forthcoming Rubiaceae treatments for the Flora Mesoamericana and Manual de Plantas de Costa Rica projects, respectively.

1. **Palicourea matamana** C. M. Taylor, sp. nov. TYPE: Costa Rica. Limón: cantón de Limón, Fila Matama, Valle de La Estrella, El Progreso, cabeceras del río Cariei, 9°47′N, 83°08′W, 1400 m, 26 Apr. 1989, *G. Herrera & A. Chacón 2805* (holotype, CR; isotypes, INB, MO-05016981). Figure 2A, B.

Haec species a *Palicourea orosiana* C. M. Taylor stipulis majoribus, lobis calycinis longioribus atque pubescentia hirsuta distinguitur.

Small trees, ca. 3 m tall; stems quadrate, hirsute with trichomes 1–2 mm long, becoming glabrescent. *Leaves* paired; *blades* elliptic, 10.5–17 × 4–6 cm, apex acuminate with tips 1–2 cm, base obtuse, drying papery, adaxially glabrous, abaxially glabrous except hirsute to hirtellous along veins; secondary veins 9 to 13 pairs, free or looping to interconnect in distal part

*This section authored by Charlotte M. Taylor, Joaquín Sánchez-González, and Roy E. Gereau.

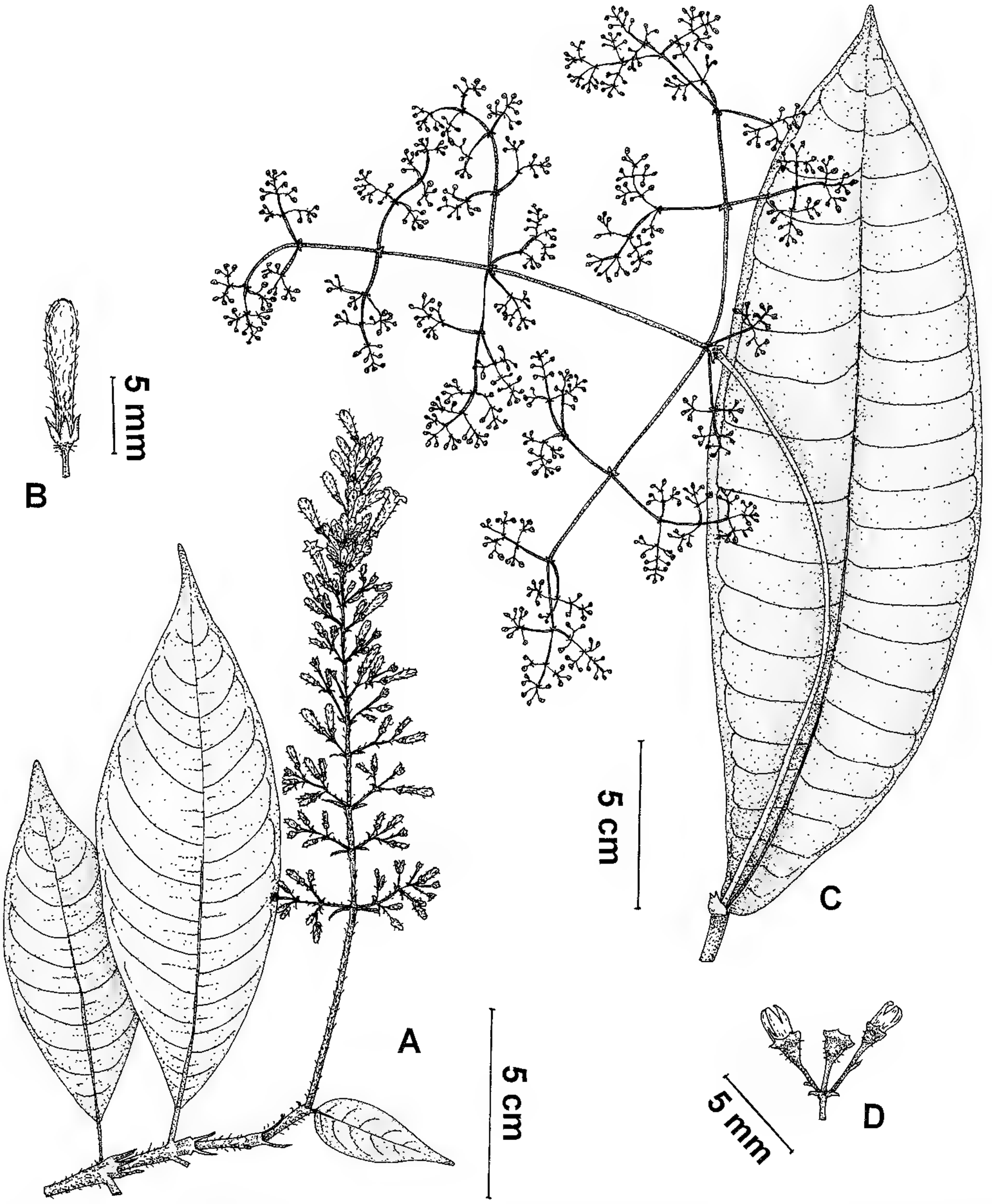

Figure 2. A, B. *Palicourea matamana* C. M. Taylor; based on the type *Herrera & Chacón 2805* (CR). —A. Portion of flowering branch. —B. Flower bud. C, D. *Psychotria herrerana* C. M. Taylor; based on the type *Herrera 3306* (MO). —C. Portion of flowering branch. —D. Portion of inflorescence with one flower from which the corolla has fallen and two flowers in bud, probably near anthesis, with the lobes spreading slightly apparently as an artifact of drying.

of blade, with 1 to 2 weak intersecondary veins usually present between each pair of secondary veins, costa, secondary, and usually tertiary venation thinly prominulous adaxially, and costa and secondary veins prominent and reticulated tertiary veins prominulous abaxially; margins entire; petioles 8–16 mm, hirsute to glabrescent; *stipules* persistent with leaves, united around stem, hirsute, sheath truncate, 6–9 mm, lobes 2 per side, narrowly triangular to linear, 8–12 mm, acute. *Inflorescence* terminal, paniculiform, erect to deflexed, hirsute, dark purple or flushed with yellow; peduncle 5–6 cm; branched portion narrowly pyramidal, 13.5–20 × 5.5–10 cm, with primary axis flexuous, with 10 to 11 pairs of developed secondary axes, these branched to 1 to 2 orders; bracts narrowly triangular, those subtending secondary axes 6–12 mm, those subtending flowers 1–3.5 mm; pedicels 3–8 mm. *Flowers* pedicellate in cymules of 3 to 5; ovary

obconic, ca. 1 mm, densely hirtellous to hirsute; *calyx* limb moderately hirtellous to hirsute, lobed nearly to base, lobes elliptic to ligulate, 1–2.5 mm, obtuse, up to ca. 60% unequal on an individual flower; *corolla* tubular, pale yellow on tube and dark purple on lobes, externally densely hirsute to hirtellous, tube 10–13 mm, lobes triangular, 2.5–3 mm, abaxially smooth. *Fruits* not seen.

Habitat, distribution, and phenology. *Palicourea matamana* is known from wet premontane forests at ca. 1400 m on the eastern slopes of the Cordillera Talamanca in central Costa Rica; it has been collected with flowers in April.

IUCN Red List category. *Palicourea matamana* meets the criterion for Critically Endangered based on its limited AOO and only one known location; because there is only one collecting locality, the EOO cannot be calculated. This species was found within a legally protected area about 20 years ago. Its overall range and its rarity or frequency cannot be evaluated from this single collection. The habitat of this location is not known to be in decline, but its condition today is not well documented. Therefore, not enough information is available to assess its conservation status, and this species is considered Data Deficient (DD).

Discussion. This new species is distinguished by the combination of its hirsute stem pubescence, its well-developed stipules, its leaf blades with the veins thinly prominulous on the adaxial surface, its relatively large dark purple or yellow-flushed inflorescence, and its calyx limb with the lobes 1–2.5 mm long and somewhat unequal on an individual flower. *Palicourea matamana* is so far known from only one specimen, but is distinct from all other known species of the genus. Its type region is rich botanically, but poorly explored; the specific epithet refers to this type region.

Palicourea matamana is similar to *P. orosiana* C. M. Taylor, but *P. orosiana* can be recognized by its smaller stipules (with the sheath 1.5–3 mm long) and its longer calyx lobes (5.5–11 mm long). *Palicourea matamana* is also similar to *P. lasiorrhachis* Oerst., but *P. lasiorrhachis* can be recognized by its stipules with generally shorter lobes (1–8 mm long), its inflorescences with the branched portion generally smaller (1–15 cm long), its generally shorter calyx lobes (0.3–1.2 mm long) that are generally similar in length on an individual flower, and its hirtellous or pilosulose pubescence, i.e., composed of shorter trichomes. In the classification of Taylor (1997), *P. matamana* belongs to *Palicourea* subg. *Montanae* C. M. Taylor; it is provisionally classified in section *Obovoideae* C. M. Taylor based on its similarity to *P. orosiana* and *P. lasiorrhachis* of that section. However, *Palicourea* sect. *Obovoideae* is diagnosed primarily by its obovoid fruits, so this classification may change when the fruits of *P. matamana* are eventually documented.

2. Palicourea providenciana J. Sánchez-Gonz. & C. M. Taylor, sp. nov. TYPE: Costa Rica. San José: Dota, Copey, Providencia, Zapotal, Finca Montaña Fría, 9°31′53″N, 83°49′52″W, 1750 m, 23 Aug. 2004, *J. Sánchez-G. & A. Rojas 1433* (holotype, CR; isotypes, K, USJ). Figure 1C, D.

Haec species a *Palicourea hammelii* C. M. Taylor stipularum lobis longioribus lanceolatis, inflorescentia flava viridiflavave atque limbo calycino breviore distinguitur.

Shrubs, flowering at 0.5 m tall, to 3 m tall; stems quadrangular, glabrous. *Leaves* paired; *blades* elliptic or elliptic-oblong, 11–17.5 × 4.3–8.5 cm, apex acuminate with tips 0.5–1.2 cm, base cuneate to obtuse, drying chartaceous, adaxially glabrous, abaxially glabrous except pilosulose or strigillose along veins; secondary veins 16 to 22 pairs, looping to interconnect in an undulating, well-developed submarginal vein situated at or up to 1 mm from margin, with 1(2) weak intersecondary vein(s) present between pairs of secondary veins, adaxially venation plane or costa and secondary veins thinly prominulous, abaxially costa, secondary, and submarginal veins prominulous and tertiary venation sparsely reticulated to subparallel and prominulous; margins entire; *petioles* 10–27 mm, glabrous; *stipules* persistent with leaves, sometimes becoming indurate with age, glabrous, united around stem, sheath concave to V-shaped between lobes, 2–5 mm, lobes 2 per side, lanceolate, 10–17 × 3–6 mm just above base, acute to acuminate. *Inflorescences* terminal, paniculiform, erect to slightly deflexed, glabrous, yellow or greenish yellow; peduncle ca. 3.5 cm; branched portion pyramidal, 2.5–6 × 3–7 cm, with 3 to 4 pairs of developed secondary axes, these branched to 1 to 2 orders; bracts narrowly triangular to narrowly ligulate, those subtending secondary axes 6–16 mm, those subtending flowers 5–9 mm; pedicels 1–3 mm. *Flowers* pedicellate in cymules of 3 to 7; ovary ca. 1.5 mm, glabrous; *calyx* limb glabrous, lobed essentially to base, lobes narrowly triangular, narrowly lanceolate, or narrowly ligulate, 4–6 mm, acute to obtuse; *corolla* tubular, white, externally glabrous, tube 7–8 mm, lobes triangular-ligulate, 2–3 mm, obtuse, abaxially smooth; *anthers* ca. 2 mm, situated below top of corolla tube; mature *stigmas* not seen. *Fruits* obovoid to ellipsoid, 4–6 × 4–5 mm, rounded

to a little flattened laterally, glabrous, blue; pyrenes 2, abaxially with 3 to 4 longitudinal ridges.

Habitat, distribution, and phenology. *Palicourea providenciana* is known from wet premontane and montane forests at 1600–2200 m on the western slopes of the Cordillera de Talamanca in central Costa Rica, in the upper Río Savegre and Río Pirrís drainages; it has been collected in flower July through October, and in fruit August through December.

IUCN Red List category. *Palicourea providenciana* meets the criterion for Critically Endangered based on its limited EOO and for Endangered based on its limited AOO plus no more than five locations. This species is not found in any internationally documented protected areas, but does live within the area of the Parque Nacional Los Quetzales that is being established with the support of the local community, as discussed in the comments below. Thus, at least some of the habitat of this species can be expected to be protected into the future. This species is assessed as Vulnerable based on its limited geographic range (VU D2); however, if the habitat of its range does begin to decline, then this species will become Endangered.

Discussion. This new species is distinguished by the combination of its relatively large stipules with the lobes lanceolate (i.e., widest just above the base), its leaf blades with numerous secondary veins that connect into a well-developed submarginal vein that is set at or very close to the revolute margins, its pyramidal inflorescences that are yellow or greenish yellow and have well-developed narrow bracts, and its well-developed calyx lobes. This species is so far known from a rather limited area; its specific epithet honors the community of the type locality, whose inhabitants are working to support the Parque Nacional Los Quetzales in order to protect the biologically rich montane forests of their region (<http://www.costaricaweb.cr/es/parque-nacional-los-quetzales-costa-rica>). *Palicourea providenciana* is similar in particular in its inflorescence form to *P. macrocalyx* Standl., but *P. macrocalyx* can be recognized by its leaves with fewer secondary veins (nine to 13 pairs), its shorter bracts subtending the flowers (1–4 mm long), its usually shorter and broader calyx lobes (3–6 mm long) that are ovate to narrowly triangular, and its yellow or greenish yellow corollas with a generally longer tube (8–13 mm long). *Palicourea providenciana* can also be confused with *P. hammelii* C. M. Taylor, but *P. hammelii* can be recognized by its triangular stipule lobes that are shorter (4–7 mm long), its pink to purple inflorescences, its longer pedicels (4–15 mm long), its longer calyx lobes (13–20 mm long), and its longer corollas (with the tube 13–20 mm long). *Palicourea providenciana* can additionally be confused with *P. lancifera* Standl. & L. O. Williams, but *P. lancifera* can be recognized by its shorter stipule lobes (1–5 mm long) and its shorter calyx lobes (1.1–3 mm long). *Palicourea providenciana* is also similar to *P. orosiana*, but *P. orosiana* can be recognized by its triangular calyx lobes and its generally narrower leaves (2.5–4.5 cm wide). In the classification of Taylor (1997), *P. providenciana* belongs to *Palicourea* subg. *Montanae* sect. *Montanae*, and within this section it belongs to the unnamed Series 3 and the unnamed Subseries f, together with *P. macrocalyx*.

Paratypes. COSTA RICA. **San José:** cantón Dota, estrib. NO del Cerro Lira, *S. Martén & G. Herrera 709* (CR, F); Copey, Providencia, Zapotal, Finca Montaña Fría, *J. Sánchez-G. 1270* (CR), *1330* (CR); cantón Pérez-Zeledón, Páramo, camino entre San Gerardo & Zapotal, *S. Lobo 440* (CR); cantón Tarrazú, cuenca de ríos Naranjo & Paquita, San Carlos, Alto San Jerónimo, *A. Rodríguez, J. González, A. Estrada & A. Quesada 8154* (INB); al lado de carr. hacia San Jerónimo, *S. Lobo 708* (CR).

PSYCHOTRIA: A NEW SPECIES, TWO NEW COMBINATIONS, AND A NEW NAME FROM COSTA RICA AND PANAMA*

Psychotria (Psychotrieae) comprises more than 1000 species of shrubs and small trees found in seasonal and wet tropical forests worldwide (Hamilton, 1989). The Neotropical species of *Psychotria* have been separated into two subgenera, *Psychotria* subg. *Psychotria* and *Psychotria* subg. *Heteropsychotria* Steyerm. (Steyermark, 1972). *Psychotria* subg. *Psychotria* comprises about 200 Neotropical species found from southern Florida and northern Mexico south to northern Argentina, and corresponds to the pantropical genus *Psychotria* s. str.; it can be recognized by its deciduous stipules and red or orange fruits (Hamilton, 1989; Taylor, 1996a; Andersson, 2002a). *Psychotria* subg. *Heteropsychotria* comprises about 600 Neotropical species also found from Florida and northern Mexico to northern Argentina, and can be recognized by its persistent stipules and blue or black fruits. The species of these two subgenera were long included together in *Psychotria* (Steyermark, 1972), but recent studies show that they are better separated and that many of the species of *Psychotria* subg. *Heteropsychotria* are more closely related to *Palicourea* than *Psychotria* (Taylor, 1996a; Bremer & Eriksson, 2009). Some

*This section authored by Charlotte M. Taylor and Roy E. Gereau.

recent authors have classified these two subgenera in different tribes, Psychotrieae and Palicoureeae, respectively (Robbrecht & Manen, 2006), but others have included them both in Psychotrieae until the entire group is better studied (Bremer & Eriksson, 2009). Many of the species of *Psychotria* subg. *Heteropsychotria* are clearly better classified in *Palicourea*, and these generic transfers are being made as individual species groups are studied in detail (Taylor et al., 2010); however, such study has not yet been done for the species of *Psychotria* subg. *Heteropsychotria* discussed in this article. Including the newly recognized species discussed in this article, 74 species of *Psychotria* subg. *Psychotria* and 68 species of *Psychotria* subg. *Heteropsychotria* are known from Mesoamerica. The description format and terminology used here follow Taylor (2006). Keys to the species of *Psychotria* in Mesoamerica and Costa Rica will be presented in the forthcoming Rubiaceae treatments for the Flora Mesoamericana and Manual de Plantas de Costa Rica projects, respectively.

1. Psychotria boraginoides (Dwyer) C. M. Taylor, comb. et stat. nov. Basionym: *Psychotria acuminata* subsp. *boraginoides* Dwyer, Ann. Missouri Bot. Gard. 67: 344. 1980. TYPE: Panama. Panamá: along Cartí–El Llano–Tupile rd., 12 mi. above Panamerican Hwy., 200–500 m, 26–27 Mar. 1993, *R. Liesner 1187* (holotype, MO 2164366; isotype, MO-2393472).

Discussion. Dwyer (1980) distinguished *Psychotria acuminata* subsp. *boraginoides* from *P. acuminata* Benth. subsp. *acuminata* based on its inflorescences with the ultimate axes unbranched or once-dichotomous, curved, reflexed, and with the flowers separated and secund along them. He did not explain the origin of the subspecific epithet, but presumably it refers to the similarity of these inflorescences to the helicoid inflorescences of some species of Boraginaceae. The inflorescence axes in both of Dwyer's subspecies of *P. acuminata* are in fact short and dichotomous initially, when the flowers are all in bud, and then elongate as the flowers and then fruits develop. The inflorescence axes typically later become helicoid in plants of *P. acuminata* subsp. *boraginoides*, and later become dichasial or also helicoid in *P. acuminata* subsp. *acuminata*. The distinctions used by Dwyer thus do not separate the two groups of plants, but the plants he included in *P. acuminata* subsp. *boraginoides* do differ significantly from *P. acuminata* subsp. *acuminata* in their leaf blades that dry stiffly papery and have the intersecondary and tertiary veins regularly developed and thinly raised on the abaxial surface, their inflorescences with the bracts all reduced or lacking, and their corollas with the tubes 6–7 mm long; versus the leaf blades drying membranous to quite thinly papery and lacking intersecondary veins or having these and the tertiary venation plane abaxially and not regularly developed, the inflorescences with several developed bracts 0.5–1 mm long subtending the secondary and sometimes higher-order axes, and the corollas with the tubes 2.5–5 mm long in *P. acuminata* subsp. *acuminata*. Accordingly, the plants of *P. acuminata* subsp. *boraginoides* are here recognized as a separate species, with the corresponding new nomenclatural combination. *Psychotria boraginoides* belongs to *Psychotria* subg. *Heteropsychotria*.

2. Psychotria croatii (Dwyer) C. M. Taylor, comb. nov. Basionym: *Cephaelis croatii* Dwyer, Ann. Missouri Bot. Gard. 67: 64. 1980. TYPE: Panama. Darién: vic. of upper gold mining camp of Tyler Kittridge on headwaters of Río Tiquesa ca. 2 air km from Cont. Divide, 26 Aug. 1972, *T. B. Croat 27204* (holotype, MO-2201416).

Psychotria purpureocapitata Dwyer ex C. M. Taylor, Novon 6(3): 301, fig. 2A, B. 1996, syn. nov. TYPE: Panama. Coclé: El Cope on Pacific side 1/2 hour walk from sawmill, 2400 ft. [732 m], 16 Oct. 1979, *T. Antonio 2154* (holotype, MO 04658112).

Discussion. The plants formerly separated in *Cephaelis* Sw. have been shown to be a heterogeneous group, with most of them belonging to *Psychotria* subg. *Heteropsychotria* (Steyermark, 1972; Taylor, 1994), but not all (e.g., Andersson, 2002b). About 150 species of *Cephaelis* have been transferred to other genera (e.g., Taylor, 1994), but several dozen names remain to be studied and reclassified: the name *C. croatii* Dwyer is one of them. This name was based on a single specimen with one inflorescence from eastern Panama, a poorly explored region. This inflorescence has a well-developed peduncle and a branched portion that is shortly cymose with seven small heads (ca. 1 cm long), and at its basalmost node a pair of free elliptic bracts ca. 10 × 6 mm. The most similar Panamanian species to *C. croatii* is *P. purpureocapitata*, and these are indistinguishable vegetatively. *Psychotria purpureocapitata* has been recognized by its different inflorescence arrangement, capitate to subcapitate with the basalmost bracts 10–15 × 10–15 mm, shortly fused at the base, and ovate, elliptic, or spatulate (Taylor, 1996b). However, study of some additional specimens reveals more variation in inflorescence arrangement than described for either of these species and also documents continu-

ous variation that links the two inflorescence forms. In particular, the specimen *J. P. Folsom, L. Collins & G. Alonzo de Monte 6662* (MO) has inflorescences with basal bracts similar to those of *P. purpureocapitata*, but seven separate small heads, with some of these similar in their size and basalmost bracts to those of *C. croatii*, but others about twice as large, i.e., intermediate in size between *C. croatii* and *P. purpureocapitata*. Additionally, the specimen *J. P. Folsom & L. Collins 6446* (MO) has two inflorescences, one with the same form as that of the type specimen of *P. purpureocapitata*, and another with the same form as that of the type specimen of *C. croatii*. Therefore, all of these plants appear to belong to the same species, which has a somewhat variable inflorescence arrangement. Accordingly, these two names are synonymized here, and because *C. croatii* is the older name, a new nomenclatural combination is made here for it in *Psychotria*. This species belongs to *Psychotria* subg. *Heteropsychotria*.

3. Psychotria herrerana C. M. Taylor, sp. nov. TYPE: Costa Rica. Limón: cantón de Talamanca, Croriña, base & ladera intermedia del Cerro Cruibeta, 9°25′N, 82°59′W, 700 m, 19 July 1989, *G. Herrera 3306* (holotype, INB; isotype, MO 4282346). Figure 2C, D.

Haec species a *Psychotria rosulatifolia* Dwyer foliis ellipticis, inflorescentia majore atque corolla minore lobis exappendiculatis distinguitur.

Small tree, ca. 3 m tall; stems glabrous, smooth, somewhat flattened. *Leaves* paired, sessile; *blade* elliptic, 20.5–30 × 4.5–8.5 cm, glabrous except principal veins puberulous abaxially, drying papery to subchartaceous, apex acute to weakly acuminate, base truncate to cordulate (and symmetrical); secondary veins 24 to 26 pairs, spreading at ca. 100°–120° from costa, apparently without domatia, extending to unite with well-developed straight submarginal vein situated 0.5–1.5 mm from margin, tertiary venation not or sparsely visible, loosely reticulate; *stipules* caducous, not seen. *Inflorescence* terminal, laxly paniculiform, puberulous or shortly hirtellous to glabrescent; peduncle flexuous, ca. 16 cm; branched portion pyramidal, ca. 25 × 26 cm, branched to 4 orders, axes flexuous, secondary axes 2 or 4 per node in unequal pairs; bracts subtending secondary axes deltate, ca. 2 mm, those subtending pedicels narrowly triangular, ca. 0.5 mm, sometimes fused in pairs; pedicels 1–2 mm. *Flowers* pedicellate in umbelliform cymules of 2 to 5; ovary portion ellipsoid to obconic, ca. 0.5 mm, puberulous; *calyx* limb ca. 0.5 mm, denticulate to shallowly lobed, puberulous to glabrescent; *corolla* in bud funnelform, at anthesis greenish yellow, externally glabrous, tube to 1 mm, internally with pilose ring just above base, lobes to 1.2 mm, ligulate, smooth abaxially; mature anthers not seen; stigmas to ca. 1 mm. *Fruit* not seen.

Habitat, distribution, and phenology. *Psychotria herrerana* is known from wet forest at ca. 700 m on the Caribbean slopes of central Costa Rica; it has been collected with flowers in July.

IUCN Red List category. *Psychotria herrerana* meets the criterion for Critically Endangered based on its limited AOO and only one known location; because there is only one collection locality, the EOO cannot be calculated. This species was found within a legally protected area about 20 years ago, in a poorly explored region. Its overall range and rarity or frequency cannot be evaluated from this single collection. The habitat of this location is not known to be in decline, but its condition today is not well documented. Therefore, not enough information is available to assess its conservation status and it is considered Data Deficient (DD).

Discussion. This new species belongs to *Psychotria* subg. *Psychotria* (Hamilton, 1989; Taylor, 2006) and is distinguished by the combination of its relatively large sessile leaves that are truncate to cordulate and clasping at the base, its numerous secondary leaf veins united into a well-developed, straight submarginal vein, its relatively large lax inflorescences borne on well-developed peduncles, and its small corollas. This striking and unusual species is named for the extraordinary Costa Rican explorer and plant collector Gerardo Herrera Chacón, who made numerous exemplary specimens of the Costa Rican flora from both accessible and remote localities. This new species is so far known from only one collection, but it is quite distinct.

Some other species of *Psychotria* subg. *Psychotria* in southern Central America have similar clasping leaves and often accumulate detritus along the stem in these cupular leaf bases. One of these is known from Costa Rica, *P. chitariana* Dwyer & C. W. Ham.; however, *P. chitariana* can be recognized by its short, subcapitate to congested-cymose inflorescences (up to 3 × 5 cm) with the axes not developed or with the axes developed but short and only branched to one to two orders, plus its larger corollas with the tubes 4–5 mm long. *Psychotria herrerana* is also similar to *P. rosulatifolia* Dwyer of Panama, but *P. rosulatifolia* differs in its cymose inflorescences that are smaller (up to 15 × 18 cm) and generally branched to only two orders, its longer corolla tubes (2.5–4 mm long),

and its corolla lobes that terminate in a linear appendage 1–2 mm long. *Psychotria herrerana* is also similar to *P. insueta* (Dwyer) Dwyer & C. W. Ham., also of Panama, but *P. insueta* can be recognized by its cymose inflorescences that are smaller (up to 15 × 18 cm) and generally branched to only two orders, its longer corolla tubes (ca. 2 mm long), and its more numerous secondary leaf veins (34 to 42 pairs). *Psychoria herrerana* is also similar to *P. megistophylla* Standl. of western Colombia, but *P. megistophylla* can be recognized by its more numerous secondary leaf veins (36 to 44 pairs), its longer corolla tubes (5–6 mm long), and its corolla lobes that terminate in a linear appendage 0.5–1.5 mm long (Taylor & Monsalve, 1997). Large and lax inflorescences similar to those of *P. herrerana* are also found in two species of *Psychotria* subg. *Psychotria* from Amazonian Ecuador, Peru, and Brazil, *P. acreana* K. Krause and *P. ceronii* C. M. Taylor, but both of these South American species can be recognized by their leaves with well-developed petioles and their submarginal leaf veins that are broadly looping and only weakly developed.

4. Psychotria tsakiana C. M. Taylor, nom. nov. Replaced synonym: *Rudgea thyrsiflora* Donn. Sm., Bot. Gaz. 61(5): 375. 1916, non *Psychotria thyrsiflora* Ruiz & Pav., 1799. TYPE: Costa Rica. Limón: Talamanca, forêts de Tsâki, 200 m, Apr. 1895, *A. Tonduz 9579* (holotype, US 943477; isotype, BR).

Discussion. This species was described in *Rudgea* Salisb. based apparently on its stipules, which have several bristles borne near the top of the sheath. The generic placement of this species was not explicitly discussed in the protologue, but *R. thyrsiflora* was classified there in *Rudgea* ser. *Notacanthe* K. Schum. *Rudgea* is diagnosed by stipules of varied form, though generally not bilobed, that have one to numerous, small to well-developed appendages, bristles, or segments that are glandular initially, i.e., on the youngest stipules at the stem apex (Taylor et al., 2004). These glandular appendages are variously small to well-developed on the youngest stipules, and then cease exudation of their mucilaginous or perhaps other glandular substances with age and either fall off when the leaves at that particular node are fully expanded, or become either hardened or indurate but not much enlarged on the older stipules, i.e., those at lower nodes. *Rudgea* ser. *Notacanthe* was characterized by its stipules with the glandular appendages positioned along the top of the interpetiolar portion of the sheath (vs. medially or basally). The stipules of *R. thyrsiflora* are united around the stem into a truncate sheath and have two well-developed lobes on each side, with several bristles borne adaxially (i.e., on the inside) near the top of the intrapetiolar portions of the sheath (i.e., above the petiole); these bristles become larger on the older stipules, and are generally exposed only when they become large enough to extend out from inside the stipule sheath, which shrinks as it ages or dries. *Rudgea thyrsiflora* is thus anomalous within *Rudgea* for its bilobed stipules and persistent appendages that are inserted inside the stipule. However, its persistent bilobed stipules and fruits that are purple-black at maturity indicate its classification in *Psychotria* subg. *Heteropsychotria*, which is related to *Rudgea* (Robbrecht & Manen, 2006). Accordingly, this species is here transferred to *Psychotria*, with the specific epithet of its new name based on the type locality.

Within *Psychotria* subg. *Heteropsychotria*, *P. tsakiana* is similar to the widespread Neotropical species *P. racemosa* Rich. in its stipule morphology, distinctive leaf venation with well-developed intersecondary and tertiary venation, inflorescences with the flowers sessile in small groups, relatively small corollas with the lobes abaxially horned or appendaged, and drupaceous fruits that are orange when immature then turn black and have five (rather than two) pyrenes that are triangular in cross section. However, *P. tsakiana* can be separated from *P. racemosa* by its narrowly pyramidal to racemiform inflorescences and its longer corollas (with the tube 4–5 mm long), versus broadly pyramidal, cymose to paniculiform inflorescences and shorter corollas (with the tube 2.5–3 mm long) in *P. racemosa*. *Psychotria tsakiana* is also similar to *P. stenostachya* Standl. of the western Amazon basin, but *P. tsakiana* is so far only known from Costa Rica and can be recognized by its longer calyx limb (0.8–1 mm long) and its larger corollas (with the tube 2.5–3 mm long), versus the calyx limb ca. 0.5 mm long and the corollas with the tube 1.5–3 mm long in *P. stenostachya*.

SIMIRA: A NEW NOMENCLATURAL COMBINATION FOR A PANAMANIAN SPECIES*

Dwyer and Hayden (1968) described *Bathysa panamensis* Dwyer based on a flowering collection from eastern Panama, *N. Bristan 1187* (MO). The classification of this species in *Bathysa* C. Presl was not explained, and at that time *Bathysa* had not been reported from Central America (Standley, 1938) or

*This section authored by Charlotte M. Taylor.

northwestern South America (Standley, 1930, 1931a, 1931b), although it was known from Peru and Bolivia (Standley, 1938). The single specimen of *B. panamensis* lacks stipules and fruits, and has a complete inflorescence with flowers in bud and at anthesis. The corolla lobes are imbricate in bud, and the floral characters of this plant are congruent with several genera of Neotropical Rubiaceae, but are not alone diagnostic for any single genus (Taylor et al., 2004). Subsequently, Dwyer (1980) recognized one species of *Bathysa* in Panama, *B. veraguensis* Dwyer, a different species from *B. panamensis*; the name *B. panamensis* was not cited in that work at all, but he did treat there the specimen *N. Bristan 1187* as the type of a newly described species, *Simira darienensis* Dwyer, apparently without realizing that this same specimen was the type of his other name. Consequently, the name *S. darienensis* is superfluous and illegitimate, because it includes the type of a previously published valid name. [This is not the only such case in this work (e.g., Taylor, 1989).]

Simira darienensis was documented with two specimens, which clearly both belong to the same species, and the second specimen, *J. Duke 8606* (MO), has immature fruits. These fruits are woody and apparently capsular, and are rather large for Rubiaceae capsules (ca. 1.5 × 1 cm). One of these fruits is partially opened and shows the several developing seeds, which are flat, about as wide as the capsule, and arranged in a vertical stack with one on top of another. This fruit morphology and in particular this seed form and arrangement are diagnostic for *Simira* Aubl. (Taylor et al., 2004). In contrast, the fruits of *Bathysa* are smaller and more thinly woody capsules, generally 3–5 × 3–5 mm, with the seeds much smaller than the width of the capsule, angled, and packed irregularly inside the locule (Germano Filho, 1998). Thus, this species belongs in *Simira*, and the corresponding new combination is made here.

Simira panamensis (Dwyer) C. M. Taylor, comb. nov.

Basionym: *Bathysa panamensis* Dwyer, Ann. Missouri Bot. Gard. 55: 34. 1968. *Simira darienensis* Dwyer, Ann. Missouri Bot. Gard. 67: 493. 1980, nom. illeg. TYPE: Panama. Darién: Río Ucurganti, 7 July 1967, *N. Bristan 1187* (holotype, MO 198219).

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Arundinella kerrii and *Dimeria kerrii*, Two New Endemic Species from Thailand (Poaceae, Panicoideae)

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ABSTRACT. *Arundinella kerrii* Teerawat. & Sungkaew and *Dimeria kerrii* Teerawat. & Sungkaew (Poaceae, Panicoideae) are validly published for the first time. Species descriptions and illustrations are provided for both taxa known only from collections from Thailand.

Key words: *Arundinella*, *Dimeria*, IUCN Red List, Panicoideae, Poaceae, Thailand.

While preparing the accounts of grass genera for the *Flora of Thailand*, two overlooked grass names were found to require validation. The names *Arundinella kerrii* and *Dimeria kerrii* were previously used by Hambananda (1990, unpublished thesis) and Nanakorn and Norsangsri (2001), respectively.

ARUNDINELLA RADDI

Arundinella kerrii Teerawat. & Sungkaew, sp. nov. *Arundinella kerrii* Hambananda, nom. inval. TYPE: Thailand. Nakhon Phanom: Tha Uthen, ca. 200 m, 16 Feb. 1924, *A. F. G. Kerr 8474* (holotype, BK; isotypes, BM, K). Figure 1.

Haec species *Arundinellae hirtae* (Thunb.) Tanaka et *A. fluviatili* Hand.-Mazz. similis, sed ab eis foliorum basalium vaginis fibrosis, glumis et lemmatibus superioribus minoribus atque calli flosculi superioris trichomatibus brevioribus ca. 1/5 lemmatis longitudinem aequantibus differt.

Perennial, loosely tufted. Culms 30–120 cm tall, erect, hollow; nodes hirsute, basal sheaths becoming fibrous. Leaf sheaths 9–16 cm, glabrate, margins hispid with tubercle-based hairs. Ligules membranous, ciliolate, 0.5–0.6 mm, with a dense row of hairs behind ligule. Leaf blades narrowly linear, (8–)20–50(–70) × 0.3–0.8 cm, glabrous on both surfaces, margins scabrous and hispid with tubercle-based hairs. Panicles contracted, 5–15 cm long; secondary axes racemose, 1.5–5 cm, alternate, rhachis scabrous. Spikelets grayish green, ovate-oblong, 3–3.6 × 1–1.5 mm; pedicels 0.2–2 mm, scabrous and hispid; lower glumes ovate, 2.5–3 × 0.8–1.2 mm, acute, 3- to 5-nerved, hispid with tubercle-based hairs on nerves; upper glumes ovate to ovate-oblong, 2.5–3.5 × 1–1.2 mm, acuminate, 5-nerved, hispid with tubercle-based hairs on nerves; lower florets male; lower lemmas ovate to ovate-oblong, 2.5–3 mm, acute, upper margins fringed, 5- or 7-nerved; lower paleas ovate-oblong, 2.5–2.7 mm; upper florets hermaphroditic, upper lemmas ovate-oblong, 1.8–2 mm, acute or mucronate or minutely bifid, shortly awned from the sinus, awns 0.5–0.6 mm, 3-nerved; upper paleas ovate-oblong, 1.8–2 mm, acute; callus pubescent, hairs 0.2–0.3 mm; anthers 0.9–1.6 mm. Caryopses not seen.

Distribution and habitat. Endemic to Thailand, this species is known only from Nakhon Phanom Province in northeastern Thailand. *Arundinella kerrii* occurs in open grasslands at an altitude of ca. 200 m.

IUCN Red List category. Using the IUCN Red List criteria (IUCN, 2001), *Arundinella kerrii* could be considered as Endangered (EN) or possibly Extinct (EX). The taxon is known only from collections made in Nahkon Phanom Province in northeastern Thailand in 1924, despite attempts by the authors to re-collect it. However, insufficient data exist regarding its conservation status, so we provisionally assign the species status as Data Deficient (DD).

Discussion. *Arundinella kerrii* is similar to *A. hirta* (Thunb.) Tanaka and *A. fluviatilis* Hand.-Mazz.,

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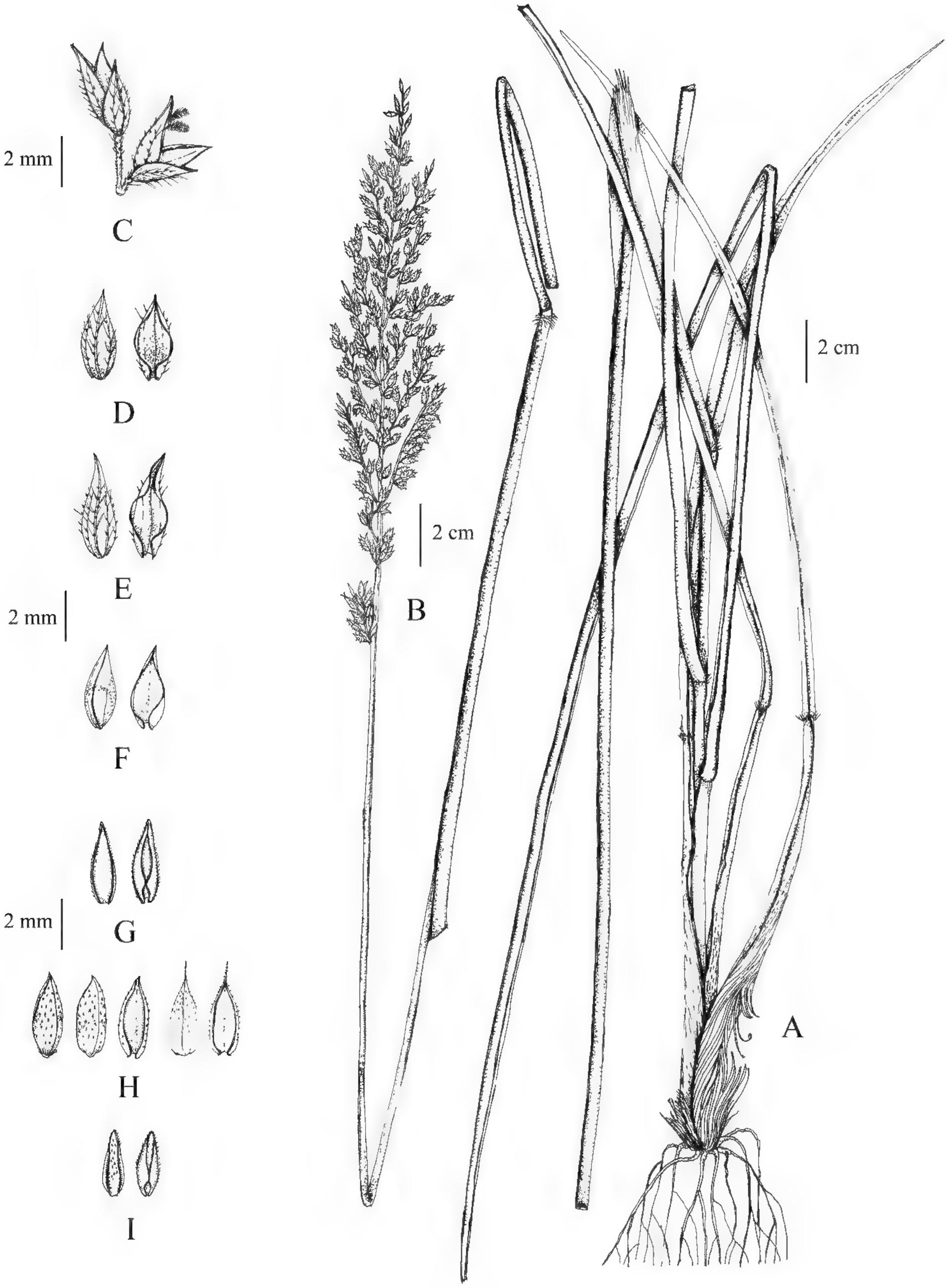

Figure 1. *Arundinella kerrii* Teerawat. & Sungkaew. —A. Habit. —B. Inflorescence. —C. Spikelets, lateral view. —D. Lower glumes. —E. Upper glumes. —F. Lower lemmas. —G. Lower paleas. —H. Upper lemmas. —I. Upper paleas. A, B drawn from *Kerr 21330* (K); C–I drawn from the holotype *Kerr 8474* (BK) by A. Teerawatananon.

but differs from them in having fibrous basal leaf sheaths, smaller glumes and upper lemma, and shorter callus hairs that are ca. 1/5 the length of the lemma. The differences among *A. fluviatilis*, *A. hirta*, and *A. kerrii* are summarized in Table 1. *Arundinella kerrii* was originally described, but not effectively published, by Hambananda (1990: 28–30) in an unpublished thesis (McNeill et al., 2006: Art. 30.5). Hambananda's description of *A. kerrii* was in Thai, but without a Latin diagnosis. In agreement with Art. 36.1 and Rec. 36A of the *International Code of Botanical Nomenclature* (McNeill et al., 2006), Hambananda's name was neither valid nor effectively published.

Table 1. Comparison of morphological characters of *Arundinella fluviatilis*, *A. hirta*, and *A. kerrii*.

Characters	*A. fluviatilis*	*A. hirta*	*A. kerrii*
Nodes	glabrous	glabrous or bearded	hirsute
Leaf sheaths	glabrous, margins ciliate	glabrous to pilose, margins ciliate or hispid with tubercle-based hairs	glabrate, basal sheath becoming fibrous, margins hispid with tubercle-based hairs
Inflorescence	an open panicle, 10–20 cm long	an open or contracted panicle, 8–45 cm long	a contracted panicle, 5–15 cm long
Pedicels	scabrous	scabrous	scabrous and hispid
Lower glumes	2.6–3.5 mm long, 5-nerved, scabrous on nerves	2.5–4 mm long, 3- to 5-nerved, scabrous on nerves (pilose with tubercle-based hairs on nerves in variety *hondana*)	2.5–3 mm long, 3- to 5-nerved, hispid with tubercle-based hairs on nerves
Upper glumes	4.5–5 mm long, scabrous on nerves	3.5–4.8 mm long, scabrous on nerves (pilose with tubercle-based hairs on nerves in variety *hondana*)	2.5–3.5 mm long, hispid with tubercle-based hairs on nerves
Upper lemmas	2.6–3.4 mm long	2.5–3.5 mm long	1.8–2 mm long
Upper lemma apex	awned, awns 0.3–1.5 mm long	acute to short mucronate	acute or mucronate or minutely bifid, shortly awned from the sinus, awns 0.5–0.6 mm long
Callus hairs	1.3–1.7 mm (ca. 1/2 length of upper lemma)	0.8–1.5 mm (1/3–1/2 length of upper lemma)	0.2–0.3 mm (ca. 1/5 length of upper lemma)

Paratype. THAILAND. **Nahkon Phanom:** Chaiyaburi, ca. 200 m, 1 May 1932, *A. F. G. Kerr 21330* (BK, BM, K).

Dimeria R. Br.

Dimeria kerrii Teerawat. & Sungkaew, sp. nov. *Dimeria kerrii* C. E. Hubb., nom. nud. *Dimeria kerrii* Nanakorn & Norsangsri, 2001, nom. nud. TYPE: Thailand. Satun: Ban Tola Tai [Tola], ca. 50 m, 3 Jan. 1928, *A. F. G. Kerr 13868* (holotype, K 648084; isotypes, BM 928281, K 648258). Figure 2.

Haec species ab omnibus congeneris thailandicis glumae superioris carina ala rugosa lata ornata differt.

Perennial. Culms up to 1.2 m tall, erect; nodes pubescent, stems waxy below nodes, usually short-noded at base. Leaf sheaths overlapping below, 6–9 cm, sparsely pilose at lower part, upper part tomentose, margins scarious. Ligules membranous, ciliolate, ca. 0.6 mm. Leaf blades linear-lanceolate, 10–20 × 3–4.5 mm, tomentose on both surfaces, sparsely pilose with tubercle-based hairs especially toward the margins, margins scabrous near the apex. Racemes (2 or)3, 8–16 cm, rhachis flattened, 0.6–0.7 mm wide, slightly zigzag, slightly ridged, ridge glabrous, narrowly winged, margins scaberulous; peduncles distally hirsute. Spikelets ovate-oblong, 5–6 × 1.8–2 mm; pedicels compressed but not flattened, 0.8–1.2 mm, margins glabrous, clavate; spikelet callus hairy, hairs up to 0.5 mm; lower glumes oblong, 5–5.5 mm, acuminate, keeled, ciliate on keel; upper glumes oblong-elliptic, 5.5–6 mm, acute to acuminate, keeled, sparsely hirsute near margins, broadly winged all along the keel, wings rugose and ciliate; lower lemmas oblanceolate or clavate, 2.5–3 mm, margins ciliate on the upper half; upper lemmas oblong-elliptic, ca. 4 mm, awns 12–15 mm, columns 2–3 mm; stamens 2, anthers 1.8–2 mm. Caryopses not seen.

Distribution and habitat. *Dimeria kerrii* is endemic to Thailand and is known only from the type locality (Satun Province in peninsular Thailand) at an altitude of ca. 50 m.

IUCN Red List category. Using the IUCN Red List criteria (IUCN, 2001), *Dimeria kerrii* could be considered as either Endangered (EN) or possibly Extinct (EX). Despite attempts by the authors to re-collect it at the type locality, it remains known only from collections last made in 1928, in Satun Province in peninsular Thailand. Because data regarding its conservation are insufficient, we provisionally assign the status as Data Deficient (DD).

Discussion. This species was first named by C. E. Hubbard on the two specimens of the *A. F. G. Kerr 13868* collection at Kew, but Hubbard never published its description. The name later appeared in an enumeration of Thai grass species (Nanakorn & Norsangsri, 2001), but a Latin diagnosis was not provided; it is therefore considered invalid in accordance with Art. 36.1 and Rec. 36A of the

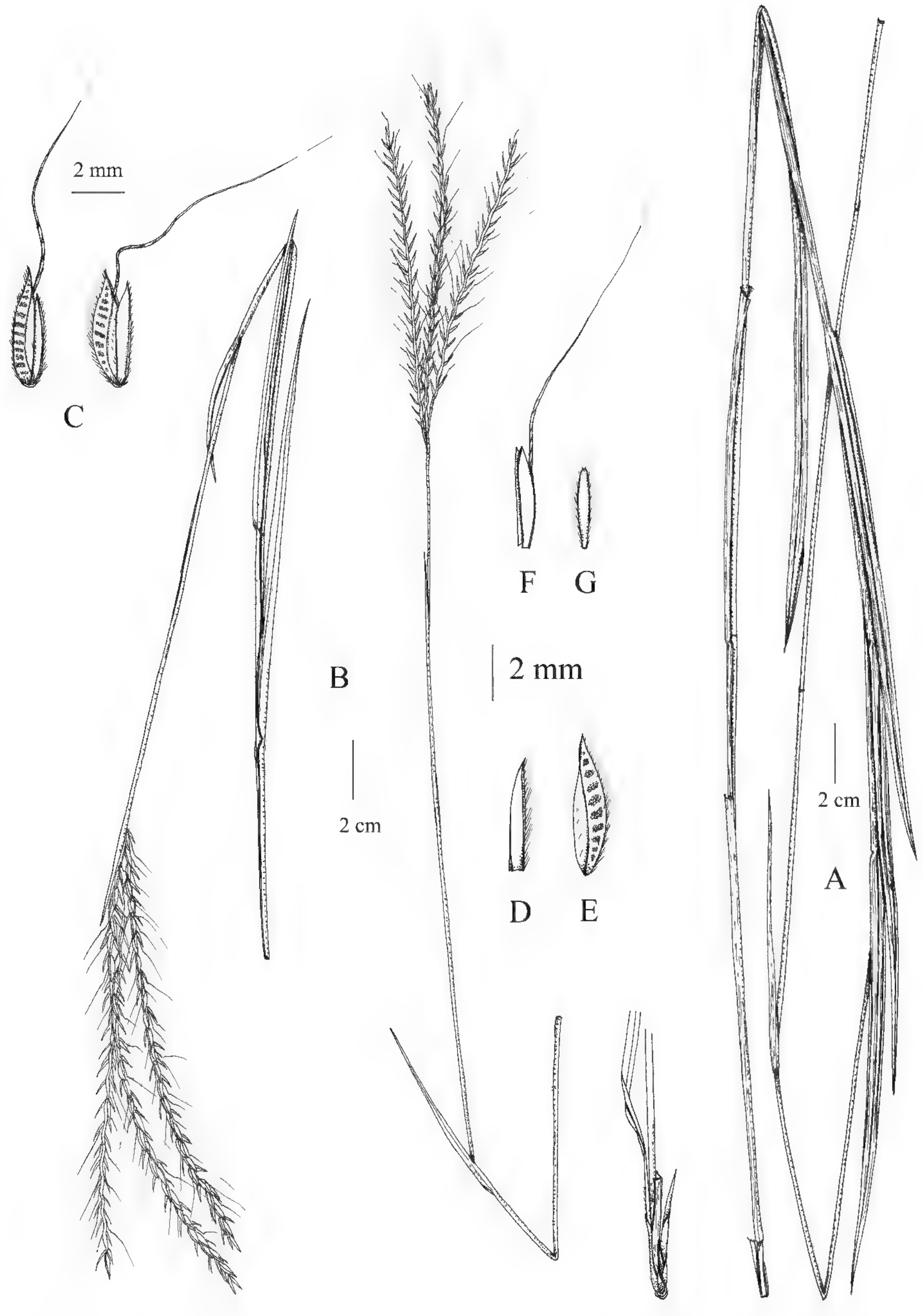

Figure 2. *Dimeria kerrii* Teerawat. & Sungkaew. —A. Habit. —B. Inflorescences. —C. Spikelets, lateral view. —D. Lower glume. —E. Upper glume. —F. Upper lemma. —G. Lower lemma. Drawn from the holotype *Kerr 13868* (K) by A. Teerawatananon.

International Code of Botanical Nomenclature (McNeill et al., 2006).

This species is distinguished from all other species of *Dimeria* by its rugose, broad wing on the keel of the upper glume.

Etymology. *Arundinella kerrii* and *Dimeria kerrii* are named in honor of Arthur Francis George Kerr (1877–1942), the Irish doctor and botanist, who undertook large botanical collections in Thailand. He collected over 25,000 herbarium specimens all over

Thailand while working for the Thai government between 1902 and 1932.

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A New Species of *Sciaphila* (Triuridaceae) from Hainan Island, China

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ABSTRACT. *Sciaphila jianfenglingensis* Han Xu, Y. D. Li & H. Q. Chen (Triuridaceae) is described and illustrated as a new species endemic to Hainan Island, China. It differs from the closely related *S. arfakiana* Becc. by its longer leaves to ca. 2 mm (vs. ca. 1 mm in *S. arfakiana*), shorter fruiting pedicels 3–6 mm (vs. typically 7–9 mm), three stamens (vs. two or three), 2-celled anthers (vs. 4-celled), and a filiform style (vs. awl-shaped) that far exceeds the ovary.

Key words: China, Hainan, IUCN Red List, *Sciaphila*, Triuridaceae.

The monocot family Triuridaceae consists of either six genera (Meerendonk, 1984) or nine genera (Maas-van de Kamer & Weustenfeld, 1998), with about 50 species distributed throughout the Old World and New World tropics (Meerendonk, 1984; Maas & Rübsamen, 1986; Mabberley, 2008; Guo & Cheek, 2010).

Sciaphila Blume is the largest genus in the family, with ca. 35 species. Hsieh et al. (2003) characterized the genus by the following features: small, achlorophyllous, mycotrophic herbs that are monoecious, with erect stems and scalelike leaves; terminal or racemose inflorescences, with male flowers acropetal; and actinomorphic flowers, with (four to) six (to 10) perianth segments basally connate. The male flowers have two to six stamens, with 1- to 4-celled anthers that are 2- to 4-lobed and dehisce extrorsely; female flowers consist of ca. 10 to 80 ovaries, each with a single ovule, with the filiform style usually exceeding the ovary; bisexual flowers have from three to six persistent stamens, with 1-celled anthers and ca. 10 to 50 ovaries. The fruit is an obovoid follicle, with a persistent style and a single seed with copious endosperm.

Individuals of *Sciaphila* are usually small in size and are not easily discerned in the field. Only five species of *Sciaphila* have been recorded from southern China and Taiwan (Zhou & Zhong, 1992; Wu et al., 2000; Ye, 2003; Hsieh et al., 2003; Zhuang et al., 2004; Guo & Cheek, 2010): *S. arfakiana* Becc., *S. maculata* Miers, *S. ramosa* Fukuy. & T. Suzuki (in Hong Kong and Taiwan), *S. secundiflora* Thwaites ex Benth. (in Guangdong, Hong Kong, and Taiwan), and *S. tenella* Blume (in Guangdong and Hainan). Recent botanical exploration in Hainan Island by the authors has revealed a new species, which is described here.

Sciaphila jianfenglingensis Han Xu, Y. D. Li & H. Q. Chen, sp. nov. TYPE: China. Hainan: Jianfengling Natl. Nature Reserve, under tropical rain forest, 18°44′N, 108°53′E, 810 m, 12 Aug. 2007, *Han Xu & H. Q. Chen JFL00891* (holotype, CANT). Figure 1.

Species *Sciaphilae arfakianae* Becc. similis, sed ab ea foliis longioribus ca. 2 mm longis, pedicellis fructiferis plerumque brevioribus 3 6 mm longis, antheris bilocularis et stylo filiformi 0.7–1.5 mm longo ovarium multo excedente differt.

Saprophytic, monoecious herbs, reddish purple, glabrous; stems erect, slender, with 1 or 2 branches ca. 8–11 cm, 0.3–0.5 mm diam. Leaves alternate, scalelike, acuminate, ca. 2 mm. Inflorescence terminal, racemose, erect, ca. 5–6 cm, with 18 to 48 flowers. Flowers unisexual, with acropetal male flowers; pedicels 3–6 mm, 0.1–0.2 mm diam., straight; bracts lanceolate, 1.2–2.1 mm; tepals 6,

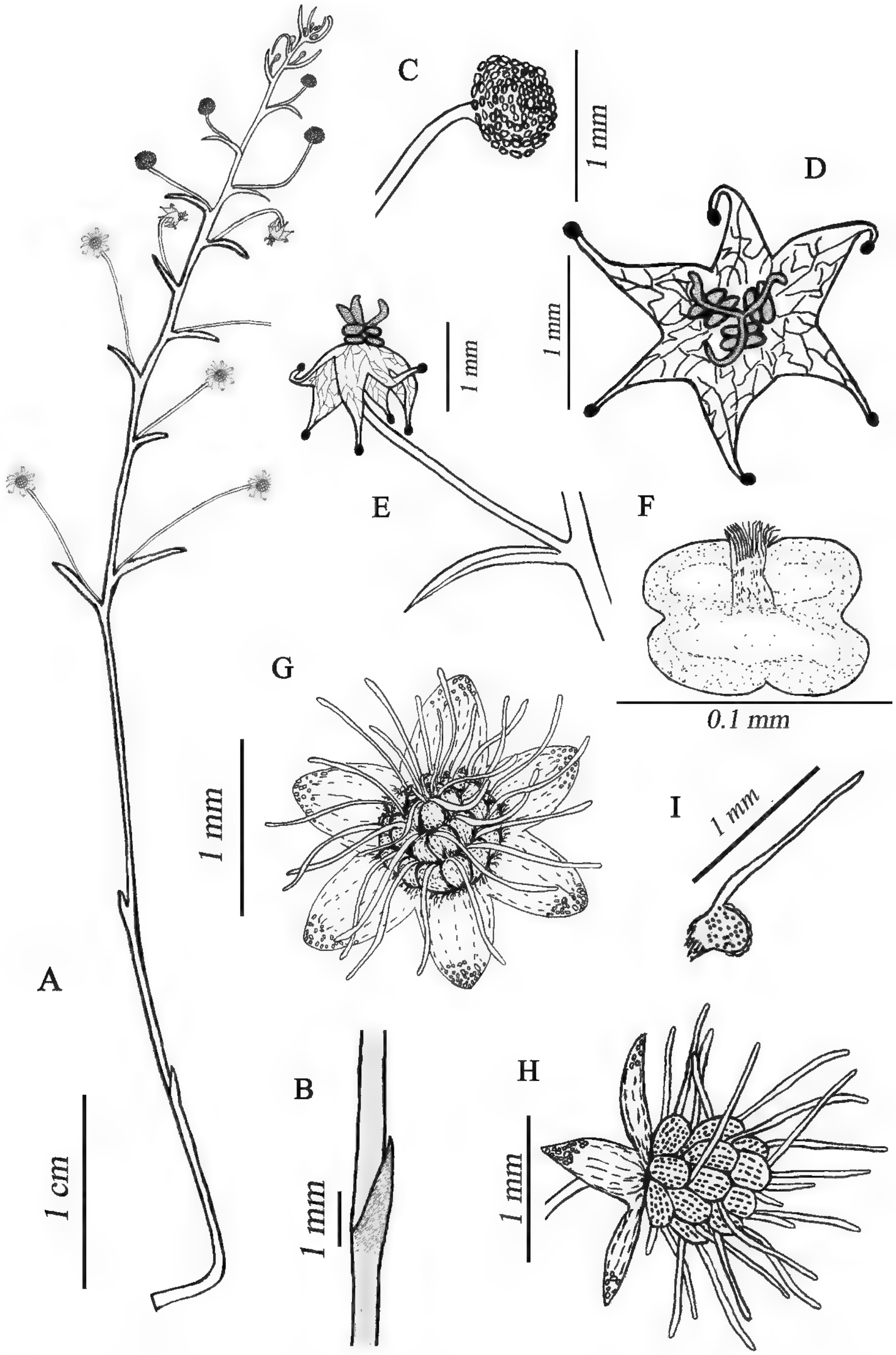

Figure 1. *Sciaphila jianfenglingensis* Han Xu, Y. D. Li & H. Q. Chen. —A. Single fertile individual. —B. Scalelike leaf. —C. Immature flower. —D. Male flower from above. —E. Male flower with bract at base of pedicel. —F. Two-celled anther. —G. Female flower from above. —H. Female flower, lateral view. —I. Ovary with laterally adnate and filiform style. Drawn by S. L. Lu from holotype *Han Xu & H. Q. Chen JFL00891* (CANT).

Table 1. Differences between *Sciaphila jianfenglingensis* and the other five *Sciaphila* species from China.*

	S. arfakiana	*S. jianfenglingensis*	*S. maculata*	*S. ramosa*	*S. secundiflora*	*S. tenella*
Plant size	6–12 cm tall; stems 0.3–0.5 mm diam.	8–11 cm tall; stems 0.3–0.5 mm diam.	10 cm tall; stems 0.6–1 mm diam.	8–12 cm tall; stems 0.3–0.5 mm diam.	4–12 cm tall; stems 0.7–1 mm diam.	7–18 cm tall; stems 0.3–0.5 mm diam.
Leaf length	ca. 1 mm	ca. 2 mm	ca. 1.2 mm	0.8–1.3 mm	2–3 mm	ca. 2 mm
Inflorescence, no. of flowers	5 to 30	18 to 48	ca. 30	3 to 7	3 to 9	ca. 4
Bisexual flower	absent	absent	present	absent	absent	present or male
Diameter, male flower	2.5–3 mm	2–2.4 mm	ca. 2 mm	ca. 2 mm	6–7 mm	ca. 2.5 mm
Stamen number	2 or 3	3	3	2 or 3	2 or 3	6
Anther sac	4-celled	2-celled	3-celled	4-celled	4-celled	3-celled
Style	awl-shaped	filiform	club-shaped	awl-shaped	club-shaped	paintbrush-shaped
Style length	ca. 1 mm	0.7–1.5 mm	ca. 0.2 mm	0.5–0.6 mm	0.6–0.7 mm	< 0.5 mm
Fruiting pedicel	(4–)7–9 mm	3–6 mm	2–2.5 mm	(1.4–)2–3.5 mm	1–2 mm	4–6 mm
Fruit diameter	ca. 2 mm	unseen	ca. 2 mm	ca. 2 mm	ca. 4 mm	1.5–2 mm

* Information for *S. arfakiana*, *S. maculata*, *S. ramosa*, and *S. secundiflora* taken from Hsieh et al. (2003).

basally connate, reflexed after anthesis. Male flowers with the tepals equal, ovate, acuminate, glabrous, ca. 0.8–1 mm, tepal apex with a stipulate, globose knob, ca. 0.1 mm; stamens 3, the anthers 2-celled, ca. 0.08 × 0.06 mm, filaments attached above the receptacle, separate, ca. 0.6 mm; dehiscence introrse and longitudinal. Female flowers with the tepals equal, ovate, glabrous, ca. 0.8–1 mm, with small granular appendages toward the acute apex; ovaries ca. 30 to 40 per flower, ca. 0.15–0.25 mm, with papillate granules, each ovary with 1 ovule; style lateral, 0.7–1.5 mm, adnate to the ovary, filiform, far exceeding the ovary. Fruits not seen.

Distribution and habitat. Only one population of *Sciaphila jianfenglingensis* was found under the canopy of tropical rainforest of Jianfengling National Nature Reserve on Hainan Island, China. This site experiences a tropical monsoon climate and the vegetation is dominated by individuals of Lauraceae, Rubiaceae, Fagaceae, Palmaceae, and Myrtaceae.

IUCN Red List category. Hainan Island is characterized by a high level of endemism. The endemic flora of Hainan comprises 397 species of seed plants in 213 genera and 74 families (Francisco-Ortega et al., 2010). Only a single population with ca. 30 individuals exists at the type locality, but it is likely that other populations exist at other localities. Therefore, *Sciaphila jianfenglingensis* is assigned a preliminary status of Vulnerable (VU D2) according to IUCN Red List criteria (IUCN, 2001), which indicated that it is a population with a very restricted area of occupancy (typically less than 20 km^2) or number of locations (typically five or fewer).

Phenology. Flowering specimens of *Sciaphila jianfenglingensis* were collected in August.

Etymology. The specific epithet is derived from the Chinese pinyin name of the collection locality of the holotype.

Taxonomic relationships. *Sciaphila jianfenglingensis* is easily distinguished from all other species of *Sciaphila* by its lanceolate fertile bracts ca. 1.2–2.1 mm, the three stamens with 2-celled anthers, and the filiform style 0.7–1.5 mm that far exceeds the ovary. Moreover, the anthers of *S. jianfenglingensis* dehisce introrsely, while those of other *Sciaphila* species dehisce extrorsely. The new species is most similar to *S. arfakiana* in having slender, reddish stems that are glabrous and sparsely branched, as well as the scalelike leaves, six tepals, and papillate ovaries. The new taxon differs by having longer leaves (to 2 mm vs. 1 mm), shorter pedicels (3–6 mm vs. typically 7–9 mm), 2-celled anthers (vs. 4-celled), and a filiform

style 0.7–1.5 mm long that far exceeds the ovary (vs. an awl-shaped style only to 1 mm in *S. arfakiana*).

Six species of *Sciaphila* are now recorded from China (cf. Table 1), with only *S. tenella* also found on Hainan Island. All these taxa are tiny and inconspicuous in the field. *Sciaphila jianfenglingensis* must be considered a rare taxon and endemic to China. The type population is small and is protected in the Jianfengling National Nature Reserve. Further study on its biology, metabolism, and ecology would contribute to our understanding of these saprophytes.

KEY FOR *SCIAPHILA* SPECIES IN CHINA

1a. Styles club-shaped or paintbrush-shaped; stems 0.6 1 mm diam.
  2a. Inflorescence ca. 30-flowered ..... *S. maculata*
  2b. Inflorescence 3- to 9-flowered.
    3a. Tepals barbate at apex ..... *S. tenella*
    3b. Tepals glabrous at apex ..... *S. secundiflora*
1b. Styles awl-shaped or filiform; stems 0.3 0.5 mm diam.
  4a. Styles short, ca. 0.5 0.6 mm ..... *S. ramosa*
  4b. Styles 0.7 mm or more in length.
    5a. Leaves ca. 1 mm long; fruiting pedicels typically 7 9 mm long; styles ca. 1 mm, awl-shaped; anther sacs 4-celled ..... *S. arfakiana*
    5b. Leaves ca. 2 mm long; fruiting pedicels 3 6 mm long; styles ca. 0.7 1.5 mm, filiform; anther sacs 2-celled ..... *S. jianfenglingensis*

Paratype. CHINA. **Hainan:** Jianfengling National Nature Reserve, under tropical rain forest, 18°44′N, 108°53′E, 810 m, 12 Aug. 2007, *Han Xu & H. Q. Chen JFL00892* (IBSC).

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Two New Species of *Uvaria* (Annonaceae) from Borneo, with a New Nomenclatural Combination

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ABSTRACT. Two new species of *Uvaria* L. (Annonaceae), *U. beccarii* Attanayake, I. M. Turner & R. M. K. Saunders and *U. curvistipitata* Attanayake, I. M. Turner & R. M. K. Saunders, are described and illustrated from Borneo. *Uvaria beccarii* is closely allied to a Peninsular Malaysian species, *U. curtisii* King, from which it differs in having distinctively nonapiculate, obovoid monocarps with a blunt, irregularly muricate surface and fewer seeds per monocarp. *Uvaria curvistipitata* closely resembles *U. javana* Dunal from Peninsular Malaysia, Sumatra, Java, and Borneo, as both species have a velutinous indument on many organs. *Uvaria curvistipitata* differs, however, in its red flowers and smaller, fewer-seeded globose to subglobose monocarps that are borne on longer, curved stipes. A new nomenclatural combination, *U. clementis* (Merr.) Attanayake, I. M. Turner & R. M. K. Saunders, is furthermore validated, based on the previously overlooked name *Artabotrys clementis* Merr., providing a legitimate name in *Uvaria* for the species. The names *U. clementis* and *U. parviflora* Hook. f. & Thomson are lectotypified here.

Key words: Annonaceae, Borneo, IUCN Red List, *Uvaria*.

Uvaria L. is one of the largest paleotropical genera in the Annonaceae (Keßler, 1993), with ca. 210 species. The genus is widespread in wet tropical lowland forests in Africa, Madagascar, continental Asia, Malesia, and northern Australia, with a center of diversity in continental Southeast Asia and Malesia (Meade, 2005). All species of *Uvaria* are woody lianas or scrambling shrubs, climbing by means of twining branchlets. The genus is characterized by the presence of stellate hairs (throughout the plant), valvate sepals, partially or fully imbricate petals, numerous stamens and carpels, monad inaperturate pollen, and monocarps with one to many seeds, generally arranged in two lateral rows (Meade, 2005; Zhou et al., 2009). The circumscription of the genus has recently been extended to include species of *Anomianthus* Zoll., *Balonga* Le Thomas, *Cyathostemma* Griff., *Dasoclema* J. Sinclair, *Ellipeia* Hook. f. & Thomson, *Ellipeiopsis* R. E. Fr., *Rauwenhoffia* Scheff., and Australian species of *Melodorum* Lour., which have all been shown to be nested within *Uvaria* in phylogenies based on chloroplast DNA sequence data (Zhou et al., 2009, 2010). The diagnostic morphological features previously used to distinguish these genera have been shown to be merely specialized adaptations of the basic *Uvaria* structure.

Although several regional taxonomic revisions of *Uvaria* have been completed—most notably for Peninsular Malaysia (Sinclair, 1955) and continental Asia north of the Isthmus of Kra (Meade, 2000)—no comprehensive taxonomic treatment has been attempted so far. Ongoing studies of *Uvaria* in Borneo indicate that there are over 30 species in the region, including two new species that are described here. A new nomenclatural combination is also validated here, associated with the recent transfer of *Cyathostemma* species to *Uvaria* (Zhou et al., 2009).

1. Uvaria beccarii Attanayake, I. M. Turner & R. M. K. Saunders, sp. nov. TYPE: Malaysia. Sarawak: Mt. Matang, 1863–1865 [1865, fide van Steenis-

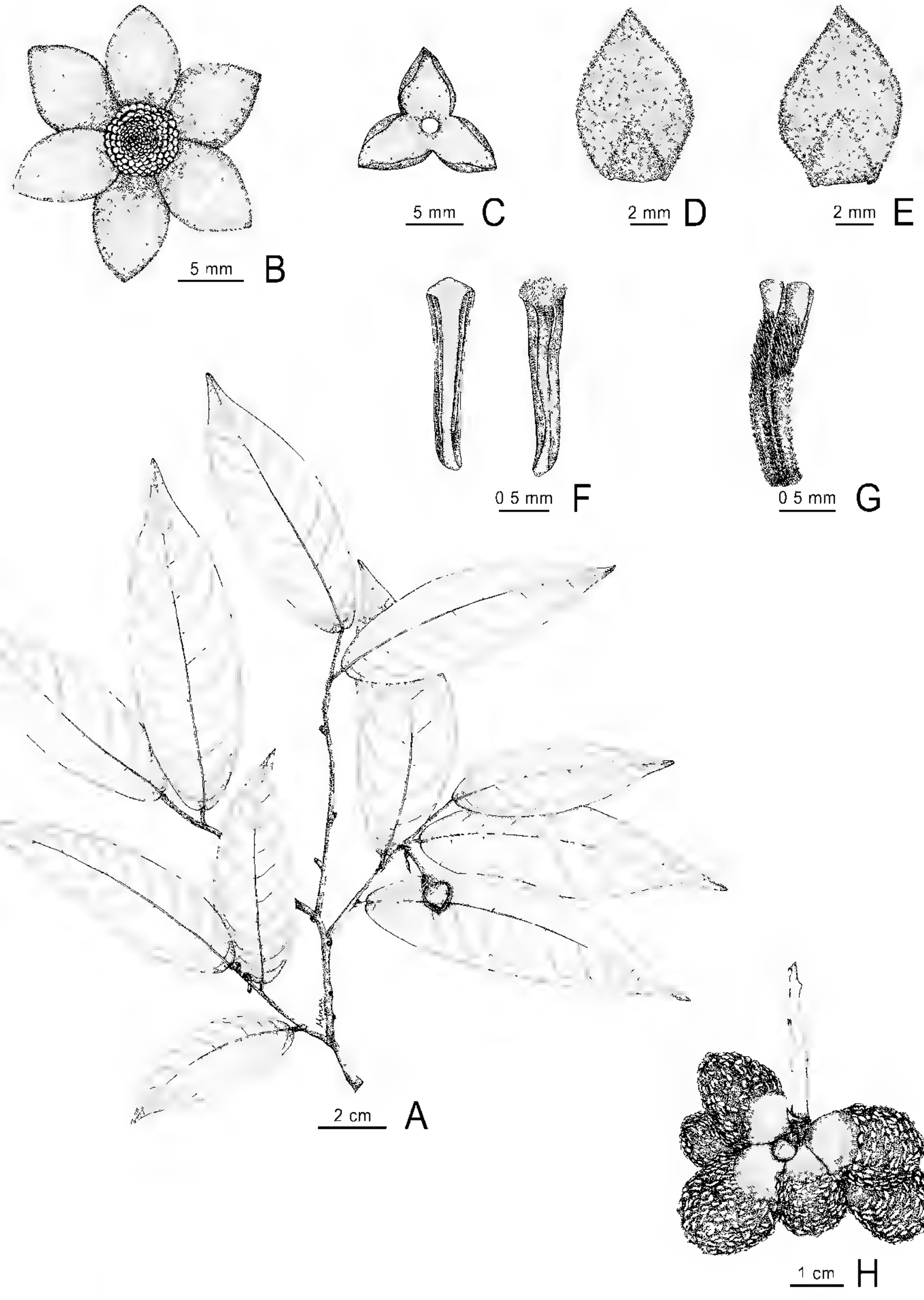

Figure 1. *Uvaria beccarii* Attanayake, I. M. Turner & R. M. K. Saunders. —A. Flowering branch. —B. Flower at anthesis. —C. Calyx with three basally connate sepals. —D. Outer petal (adaxial view). —E. Inner petal (abaxial view). —F. Stamens (adaxial view [left] and abaxial view [right]). —G. Carpel. —H. Fruit, with proximal monocarps removed. A drawn from *Abbe et al. 10267* (E); B–G from *Anderson S16410* (L, SAR, SING); H from *Lee & Paie S37958* (L).

Kruseman, 1950: 43], *O. Beccari P.B. 1648* (holotype, K; isotypes, BO, FI-B). Figure 1.

Species haec ab *Uvaria curtisii* King foliorum basibus cuneatis vel subcordatis, sepalis in fructu persistentibus, monocarpidiis sessilibus obovoideis (apicibus rotundatis) irregulariter muricatis, diaphragmatibus inter semina membranaceis atque seminibus in quoque monocarpidio paucis (4 ad 7) differt.

Large woody climbers, to 25 m high; twigs drying dark gray or gray-brown, bark minutely latticed longitudinally, younger parts densely covered with brown stellate hairs, ca. 0.5 mm. Leaves chartaceous, drying dark brown or gray-brown adaxially, dark brown to brown abaxially; laminas elliptic to narrowly obovate, 7–15 × 2.5–5.5 cm, glabrous adaxially, but densely hairy over midrib, sparsely hairy abaxially,

but densely hairy over veins, blade base subcordate to cuneate, apex acute to broadly acuminate, margin generally hairy, not thickened, not revolute; midrib slightly sunken adaxially in dry leaves, prominent abaxially; secondary veins 11 to 15 pairs per leaf, arching forward, looping obscurely well within margin, ± flush adaxially, prominent abaxially; tertiary venation reticulate, visible abaxially, obscure adaxially; petioles 2–7 × 1–1.9 mm, generally with transverse ringlike markings, densely hairy. Inflorescences supra-axillary to subopposite, 1- or 2-flowered; peduncles 1–2 mm, without bracts; flower pedicel 12–22 × 0.8–1.4 mm, densely hairy with brown hairs; basal bract narrow, leaflike, not clasping pedicel, 3–5.5 × 1–2 mm, sparsely hairy adaxially, densely hairy abaxially; median bract on the upper half of pedicel, narrow, leaflike, 2.5–3.5 × 1.5–2 mm, subglabrous adaxially, densely hairy abaxially. Calyx completely covering immature flower bud, splitting almost to base at maturity, persistent on fruit; sepals triangular, 6–11 × 6.5–9.5 mm, drying dark brown with granular black dots on both surfaces, sparsely hairy (denser toward base) abaxially; petals white, pale yellow, or greenish yellow, spreading at anthesis, inner and outer whorls subequal, slightly imbricate, ovate-elliptic, ca. 10 × 5 mm, densely hairy adaxially and abaxially, with short pale brown hairs, midrib visible, apex obtuse; stamens ca. 300 per flower; connective truncate, papillate; carpels ca. 35 to 40 per flower, ca. 2 mm; stigma split funnel-shaped; ovary angular, hairy; floral receptacle ovoid, apically flattened, ca. 3.5 mm diam. Fruiting peduncles 5–14 × 2–3.7 mm; fruiting pedicels 16–25 × 2.8–4 mm, drying striate, brown, sparsely hairy; fruiting receptacle densely hairy, ca. 10 mm diam. Monocarps greenish brown, 8 to 15 (or more) per fruit, obovoid, 2–3.5 × 1.5–2.5 cm, monocarp surface irregularly muricate, drying brown, densely hairy, with short golden hairs, apex rounded, base acute; pericarp thick, 1.7–3.8 mm; stipes absent; seeds 4 to 7 per monocarp, attached laterally in 2 rows, separated in monocarp by membranous diaphragms, ellipsoidal with 1 or 2 flattened faces, ca. 12 × 6–8 × 3–6 mm, drying brown, smooth, shiny; aril, raphe, and hilum unclear.

Distribution and habitat. *Uvaria beccarii* is endemic to Borneo (Brunei, Sabah, and Sarawak; Fig. 2). It is known from lowland dipterocarp forests (primary and disturbed), near streams and freshwater swamps, at elevations from 30 to 720 m.

IUCN Red List category. *Uvaria beccarii* is assessed as Near Threatened (NT) according to IUCN Red List categories and criteria (IUCN, 2001). Although the new species is represented by only nine herbarium collections from seven disparate localities, the species does not meet the criteria for the Vulnerable (VU) category as the extent of occurrence exceeds 20,000 km². The collections are generally old, with only three collections since the 1970s. Although five of the collections are from comparatively well-protected areas (Semengoh Arboretum, Sarawak; Belait, Brunei; and Bongaya and Kelumpang Forest Reserves, Sabah), one is from an area subject to severe logging (Batu Laga, Ulu Belaga, Sarawak). The localities of collections are geographically distant (Fig. 2), suggesting possible fragmentation. The Near Threatened (NT) category is recommended as forest depletion is prevalent due to extensive logging, agricultural practices, and urbanization (Barraclough & Ghimire, 2000).

Phenology. Flowering specimens were collected between April and June; only two fruiting specimens are known, collected in September and October.

Etymology. The specific epithet honors Odoardo Beccari (1843–1920), who extensively collected Bornean plants, including the type collection of this species. Beccari appears to have recognized that the specimen represented a new species and distributed the material under the ined. name *Uvaria vallombrosana*, the proposed epithet deriving from the name of the house, "Vallombrosa," he had built on Mt. Matang in Sarawak.

Discussion. *Uvaria beccarii* is closely associated with a group of species that includes *U. calamistrata* Hance, *U. curtisii* King, *U. hirsuta* Jack, and *U. grandiflora* Roxb. ex Hornem. These species possess leaflike bracts that do not clasp the pedicel, a calyx that entirely covers the immature flower bud and that later splits into a variable number of segments at anthesis, stamens with a truncate connective, and densely tomentose monocarps. Among these species, *U. beccarii* is most similar to *U. curtisii* (King, 1893; Sinclair, 1955; Attanayake, pers. obs.), as they both have few-flowered inflorescences with white or pale yellow flowers, and sepals with inconspicuous venation and black glandular cells. *Uvaria curtisii* can be distinguished from *U. beccarii*, however, by its leaves that have an acute to obtuse base and by the monocarps that are cylindrical, apiculate, have a smooth surface, and have more seeds per monocarp (12 to 14).

The fruits of *Uvaria beccarii* are morphologically similar to those of the Bornean species *U. verrucosa* Scheff. (Scheffer, 1885), although the two species are unlikely to be confused if flowering material is available. *Uvaria verrucosa* fruits are borne on shorter

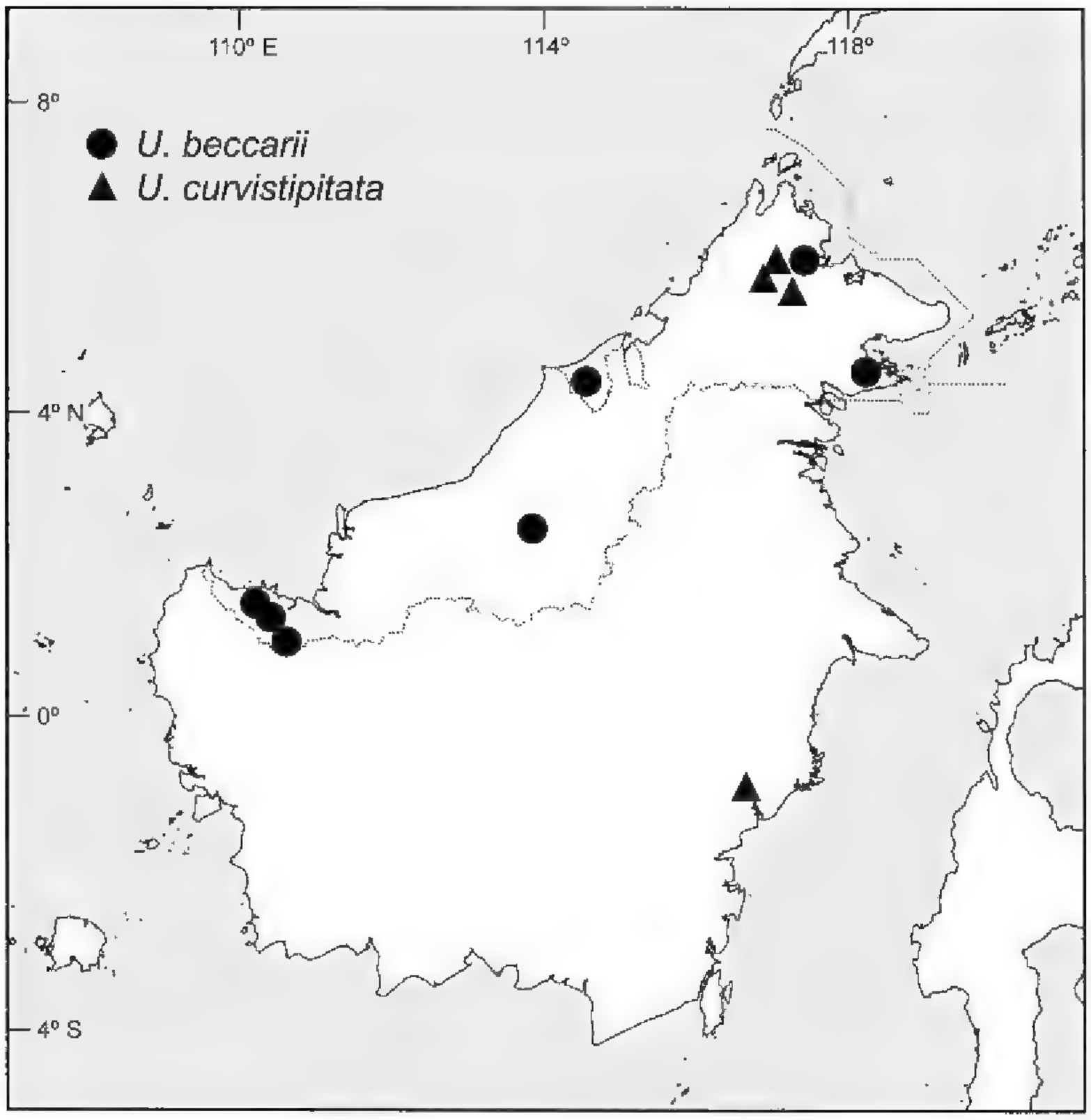

Figure 2. Distribution of known collections of *Uvaria beccarii* and *U. curvistipitata* in Borneo.

peduncles and pedicels (ca. 1.5 mm and 6–7 mm, respectively), have a smaller receptacle (3.5–5.5 mm diam.), and the monocarps are smaller (ca. 9–16 × 10–12 mm), subglobose with an apiculate apex, and have fewer seeds (one to three).

Paratypes. BRUNEI. **Belait:** on Belait River upstream from Malayan River, Belait, 23 Oct. 1988, *Wong Khoon Meng WKM 570* (K). MALAYSIA. **Sabah:** Beluran Distr., Bongaya Forest Reserve, 17 July 1975, *Aban & Kodoh SAN 81977* (K); Mostyn Distr., Kelumpang Forest Reserve mi. 17, 13 Apr. 1966, *H. T. Sinanggul SAN 54532* (SAN). **Sarawak:** Kuching Div., 53 mi. from Kuching, Sungai Engkabang, 1°2′N, 110°40′E, 12 May 1962, *L. B. Abbe, E. C. Abbe, J. A. R. Anderson, Haji Suib, Mansor, Banying & Sibat 10267* (E, K); Kuching Div., Serian, 53rd mi. Simanggang Rd., Sungai Engkabang, 12 May 1962, *J. A. R. Anderson S16410* (K, L, SAR, SING); Kuching Div., Semengoh Forest Research Arboretum, 18 Oct. 1962, *Rosli S14780* (K, KEP, L); Kuching Div., Semengoh Arboretum, 9 Sep. 1976, *B. Lee & I. Paie S37958* (K, L, SING); N of Dataran, Batu Laga, Ulu Belaga, 24 June 1995, *S. T. Lai, Rantai et al. S72451* (L).

2. Uvaria curvistipitata Attanayake, I. M. Turner & R. M. K. Saunders, sp. nov. TYPE: Malaysia. Sabah: Labuk & Sugut, W side of Bukit Doji pass from Telupid to Ulu Karamuak, 25 Oct. 1968, *S. Kokawa & M. Hotta 435* (holotype, SAN; isotypes, KYO, L). Figure 3.

Species haec ab *Uvaria javana* Dunal pedicellis brevioribus (6 8 mm), petalis ovatis rubris, monocarpidiis globosis ad subglobosis (axibus rectis) laevibus vel inconpicue undulatis stipitibus longioribus (ca. 39 mm) curvis insidentibus atque seminibus paucis (2 ad 6) differt.

Large woody climbers, maximum height unknown; twigs drying dark brown or black, bark minutely striate longitudinally, younger parts densely covered with brown stellate hairs ca. 1 mm. Leaves chartaceous to coriaceous, drying brown or gray-brown adaxially, brown abaxially; laminas typically obovate, 12–25 × 6.5–13 cm, variably hairy adaxially, sometimes only over veins, densely hairy abaxially, base subcordate to cordate, apex obtuse to shortly acuminate, margin densely hairy, slightly thickened, slightly revolute; midrib flush or slightly sunken adaxially in dry leaves, prominent abaxially; secondary veins 13 to 19 pairs per leaf, arching forward, looping obscurely well within margin, ± flush adaxially, prominent abaxially; tertiary venation reticulate, visible abaxially, obscure adaxially; petioles 5–15 × 1.7–5 mm, smooth, densely hairy.

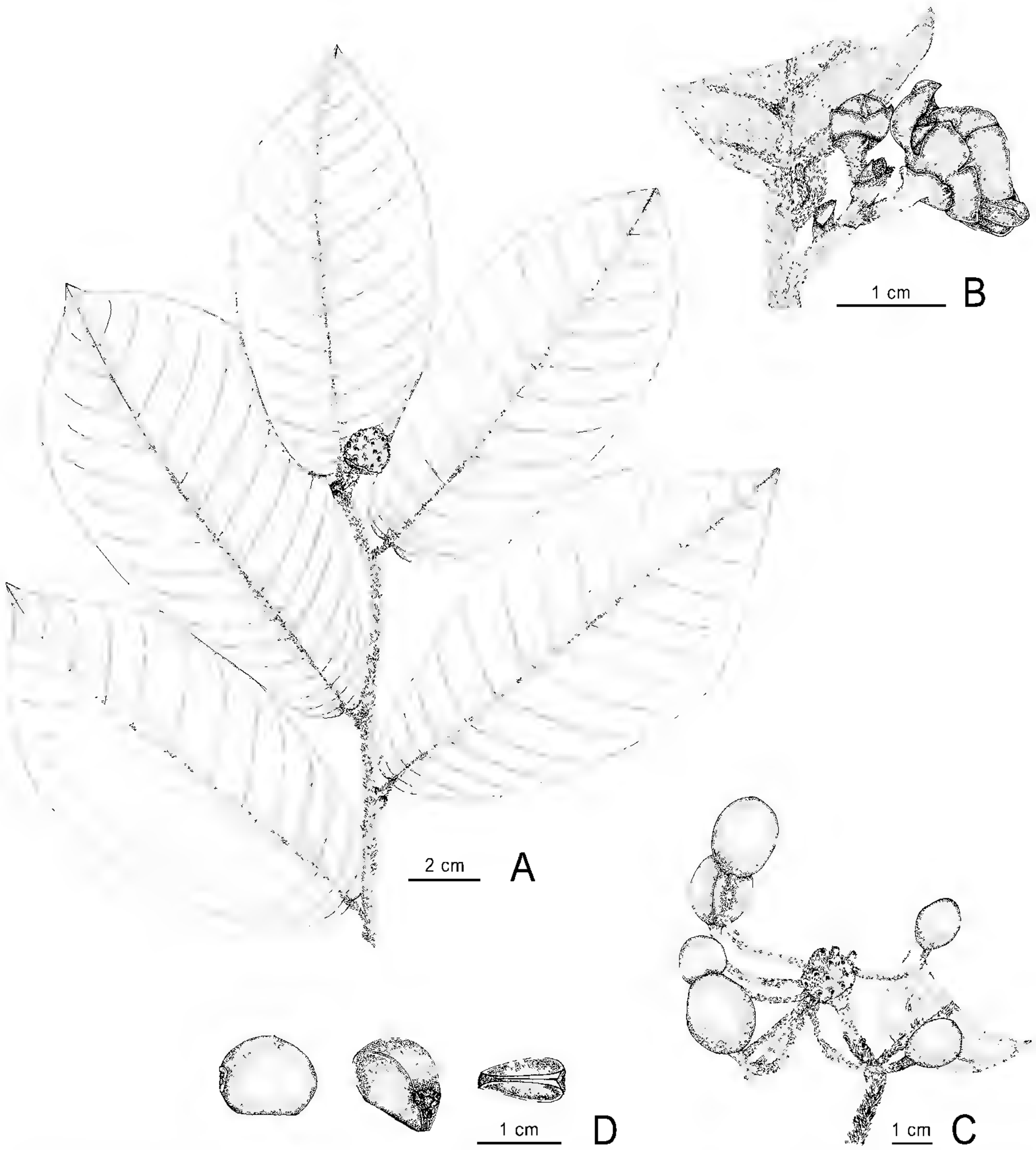

Figure 3. *Uvaria curvistipitata* Attanayake, I. M. Turner & R. M. K. Saunders. —A. Fruiting branch. —B. Inflorescence. —C. Fruiting branch. —D. Seeds (three views). A, C, D drawn from *Sigin et al. SAN 56772* (K, KEP); B from the holotype *Kokawa & Hotta 435* (SAN).

Inflorescences supra-axillary, 2- to 4-flowered; peduncles 3.5–4 mm, without bracts. Flower pedicel 6–8 × 2.1–2.3 mm, densely hairy with brown hairs; basal bract broadly ovate, clasping pedicel, size unknown, densely hairy adaxially and abaxially; median bract on the upper half on pedicel, broadly ovate, 3–5.5 × 7–8 mm, densely hairy adaxially and abaxially; calyx exposing apex of immature flower bud, splitting halfway to base at maturity; sepals broadly ovate, ca. 5 × 7 mm, drying brown, smooth on both surfaces, densely hairy abaxially; petals red, partially open at anthesis, inner and outer whorls subequal, slightly imbricate, ovate, ca. 8 × 8 mm, densely hairy adaxially and abaxially, with short pale brown hairs, midrib visible, apex obtuse; stamens and carpels not seen. Fruiting peduncles 3–9 × 3.2–3.7 mm; fruiting pedicels 8–16 × 3.8–4.5 mm, drying minutely striate, brown, densely hairy; fruiting receptacle densely to scattered hairy, 13–16 mm diam. Monocarps greenish, 27 to 36 per fruit, globose to subglobose, 1.5–2 × ca. 1.5 cm, surface ± smooth to inconspicuously undulate, sometimes with longi-

Table 1. Summary of morphological differences between *Uvaria curvistipitata*, *U. javana*, and *U. excelsa* (Attanayake, pers. obs.).

	U. curvistipitata	*U. javana*	*U. excelsa*
Vegetative indument length	medium to long hairs	short to medium hairs	short to medium hairs
Petiole rings	absent	present or absent	present
Inflorescence size	2 to 4 flowers, comparatively separated on rachis	1 to 3 flowers, comparatively separated on rachis	2 to 20 flowers, crowded on rachis
Pedicel length	6–8 mm	10–27 mm	2–5 mm
Sepal fusion	basally connate	basally connate	free
Petal color	red	yellow	yellow to rusty red
Outer petal shape	ovate	elliptic	broadly ovate
Fruit peduncle length	3–9 mm	2–3 mm	up to 2 mm
Fruit pedicel length	8–16 mm	7.5–17 mm	1.5–5 mm
Stipe length	ca. 39 mm	ca. 15 mm	22–29 mm
Stipe shape	curved	straight	straight
Monocarp size	15–20 × 14–16 mm	20–33 × 16–22 mm	17–31 × 15–24 mm
Monocarp shape	globose to subglobose, axis straight	elliptic, axis curved	subglobose, axis straight
Monocarp surface	inconspicuously undulate or smooth	slightly rugulose	inconspicuously undulate or smooth
Diaphragm separating seeds	membranous	membranous	thick
Seeds per monocarp	2 to 6	4 to 16	2 to 11

tudinal ridges, drying brown, densely hairy, with short golden hairs, apex rounded, base rounded; pericarp thick, 1.2–1.8 mm; stipes ca. 39 mm long, ca. 2.2 mm thick; seeds 2 to 6 per monocarp, attached laterally in 2 rows, separated in monocarp by membranous diaphragms, ellipsoidal with 1 or 2 flattened faces, 10.5–12 × 7.5–9.5 × 4–6.5 mm, drying brown, smooth, shiny, arillate, raphe ridged, hilum V-shaped.

Distribution and habitat. *Uvaria curvistipitata* is endemic to Borneo (Kalimantan Timur and Sabah; Fig. 2). It has been collected from lowland forests (including disturbed areas), at elevations from 20 to 200 m.

IUCN Red List category. *Uvaria curvistipitata* is assessed as Vulnerable, VU B1ab(iii), according to IUCN Red List categories and criteria (IUCN, 2001). Despite the comparatively intense botanical collecting in Sabah, *U. curvistipitata* has not been collected in the region since 1984, although a later collection (dating from 1990) was made in Kalimantan Timur. None of the collection localities are within protected areas, and Bintang Mas (Sabah) and Kenangan (Kalimantan Timur) have been severely logged. East Kalimantan has been extensively exploited since 1960 for its natural resources, including timber, oil, gas, coal, and other minerals (Fatawi & Mori, 2000). Prolonged droughts (in 1982–1983 and 1997–1998) and forest fires (in 1998) caused severe damage to the Balikpapan area (van Nieuwstadt & Sheil, 2005). The extent of occurrence of this species is less than 20,000 km² and therefore the Vulnerable category is recommended.

Phenology. Three specimens are known with flowers collected between August and November; only one fruiting specimen is known, collected in April.

Discussion. Data on the inflorescence and flower structure in *Uvaria curvistipitata* are limited as the holotype and isotypes are the only collections available that have mature flowers. The species most closely resembles *U. javana* Dunal (Boerlage, 1899; Sinclair, 1955), which has previously been recorded from the Andaman Islands, Peninsular Malaysia, Sumatra, Java, and Borneo (Merrill, 1929; Sinclair, 1955). Fruiting material of *U. curvistipitata* has furthermore previously been confused with more densely hairy specimens of *U. excelsa* (Hook. f. & Thomson) King (Utteridge, 2000, as *Cyathostemma excelsum*). Differences between *U. curvistipitata*, *U. javana*, and *U. excelsa* are detailed in Table 1.

Paratypes. INDONESIA. **Kalimantan Timur [East Kalimantan]:** Balikpapan, Sepaku area, Kenangan, PT. ITCI, 10 Nov. 1990, *K. Sidiyasa 490* (L). MALAYSIA. **Sabah:** Sandakan Distr., Sungai Kun Kun, 2 Apr. 1984, *Sigin et al. SAN 56772* (K, KEP, L, SAN); Sandakan Distr., Keramuak, Bintang Mas logging area, 28 Aug. 1975, *T. Arsid SAN 81504* (K, L, SAN).

3. Uvaria clementis (Merr.) Attanayake, I. M. Turner & R. M. K. Saunders, comb. nov. Basionym:

Artabotrys clementis Merr., J. Straits Branch Roy. Asiat. Soc. 85: 174–175. 1922. TYPE: Borneo. Sabah: Sandakan & vic., Batu Lima & Sibuga, Sep.–Dec. 1920, *M. Ramos 1667* (lectotype, designated here, K; duplicate, A).

Uvaria parviflora Hook. f. & Thomson, Fl. Ind. 1: 103. 1855, non *Uvaria parviflora* A. Rich., Fl. Seneg. Tent. 1: 9, tab. 3, fig. 1. 1831, nec *Uvaria parviflora* (Michx.) Torr. & A. Gray, Fl. N. Amer. [Torr. & A. Gray] 1: 45. 1838. *Uva parviflora* Kuntze, Revis. Gen. Pl. 1: 8. 1891, replacement name for *Uvaria parviflora* Hook. f. & Thomson. *Cyathostemma hookeri* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 61(1): 10. 1892, nom. illeg. superfl. *Uvaria kingii* L. L. Zhou, Y. C. F. Su & R. M. K. Saunders, Syst. Biodivers. 7: 255. 2009, nom. illeg. superfl. TYPE: [Malaysia.] Peninsular Malaysia, Prince of Wales Island [Penang], s.d., *W. E. Phillips s.n.* (lectotype, designated here, K 000615957).

Discussion. This species was first described as *Uvaria parviflora* by Hooker and Thomson (1855). Unfortunately, this was a later homonym, the species name having already been used twice before (Richard in Guillemin & Perrottet, 1831; Torrey & Gray, 1838). King (1892) considered the species a member of the genus *Cyathostemma* and described it as *C. hookeri* King, citing *U. parviflora* Hook. f. & Thomson in synonymy and explicitly including its type in the new species. Given that *U. parviflora* was a later homonym, this would not have affected the legitimacy of *C. hookeri* King, if it were not for the fact that Kuntze (1891) had already transferred *U. parviflora* Hook. f. & Thomson to his new genus *Uva* (a superfluous substitute for *Uvaria* L.). The name *Uva parviflora* Kuntze must be considered an avowed substitute for *Uvaria parviflora* Hook. f. & Thomson (McNeill et al., 2006: Art. 58.1, Ex. 1), and King's name *C. hookeri* is superfluous and illegitimate because the name *C. parviflorum* was not pre-empted (McNeill et al., 2006: Art. 55.1, Ex. 1), and automatically typified by the type of *Uvaria parviflora* Hook. f. & Thomson. This in turn makes the name *Uvaria kingii* L. L. Zhou, Y. C. F. Su & R. M. K. Saunders (proposed as a substitute for *C. hookeri*, as the name *Uvaria hookeri* was not available) superfluous and illegitimate also.

Zhou et al. (2009) overlooked the presence of a synonym that could provide a combination in *Uvaria*, however. Merrill (1922) described *Artabotrys clementis* Merr. from Sabah in Borneo. It seems very likely that Merrill actually intended to publish *Uvaria clementis*: the type specimen was distributed under this name, and in the description the new species is compared with *U. lurida* Hook. f. & Thomson. The name clearly appears under *Artabotrys* rather than *Uvaria* in the publication, however, and since Merrill did not publish a correction, its transfer to *Uvaria* is required. The holotype was deposited in PNH but was destroyed during World War II; we have accordingly selected a lectotype from K.

There are two sheets in the Kew herbarium that represent original material of *Uvaria parviflora* Hook. f. & Thomson. The only collection information they possess is the annotation as Prince of Wales Island. The two sheets are not labeled as being part of the same specimen and therefore must be considered as separate specimens (McNeill et al., 2006: Art. 8.3). One of the two is therefore designated lectotype here.

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A New Species of *Pera* (Euphorbiaceae) from Amazonian Brazil

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Abstract. A new species of Euphorbiaceae from the Brazilian Amazon, *Pera eiteniorum* Bigio & Secco, is described and illustrated. This species is closely related to *P. tomentosa* (Benth.) Müll. Arg., *P. membranacea* Leal, and *P. heteranthera* (Schrank) I. M. Johnst., but can be distinguished from them by the following characteristics: the abaxial leaf surface with stellate trichomes and the blade midvein with stellate-lepidote trichomes, staminate flowers with the calyx glabrous or rarely with sparse, sericeous trichomes, and a well-developed rudimentary pistillate flower with a lageniform (flask-shaped) ovary, triangular stigma, and narrowly oblanceolate staminode. Affinities of the new taxon are discussed, and a key to morphologically similar species from Amazonian Brazil is presented.

Resumo. Uma nova espécie de Euphorbiaceae da Amazônia brasileira, *Pera eiteniorum* Bigio & Secco, é descrita e ilustrada. Esta espécie é superficialmente semelhante a *P. tomentosa* (Benth.) Müll. Arg., *P. membranacea* Leal e *P. heteranthera* (Schrank) I. M. Johnst., mas separa-se por ser a única deste grupo a apresentar as seguintes características: face abaxial das folhas com tricomas estrelados e estrelados lepidotos na nervura principal, cálice das flores estaminadas glabros ou raramente com tricomas seríceos esparsos e rudimento de flores pistiladas bem desenvolvido; flores pistiladas com ovário lageniforme, estigma triangular e estaminódio estreitamente oblanceolado. Discussão sobre as afinidades do novo táxon, bem como uma chave para separação das espécies morfologicamente relacionadas da Amazônia brasileira, é apresentada.

Key words: Amazonia, Brazil, Euphorbiaceae, IUCN Red List, *Pera*, Peraceae.

Pera Mutis is a genus endemic to the Neotropics (Gordillo & Morrone, 2005), encompassing about 30 species (Webster, 1994; Gillespie & Armbruster, 1997), occurring from Cuba and Central America to southern Brazil (Rio Grande do Sul State). The Amazonian region has the highest species diversity of the genus (Webster, 1994). The genus presents a morphological character that is unique among the Euphorbiaceae: the pseudanthia (a cymose inflorescence), which can be either unisexual or bisexual as exemplified by *P. distichophylla* (Mart.) Baill. and *P. androgyna* Rizzini, consisting of minute flowers enveloped by a fragrant, somewhat globose, showy (yellow, cream, white, and sometimes red) involucral bract. Two species are known to have ethnobotanical uses: *P. glabrata* (Schott) Baill., which is used to make wooden clogs in Brazil (Lorenzi, 1992), and *P. benensis* Rusby, used by the Chimane Indians from Bolivia to treat cutaneous leishmaniosis (Fournet et al., 1992).

The most recent works on *Pera* are those of Gillespie and Armbruster (1997), treating five species of the Guianas, and Gillespie (1999), treating the six species of the Venezuelan Guayana. The most complete work, however, continues to be that of Pax and Hoffmann (1919). Traditionally, *Pera* has been placed in Euphorbiaceae subfam. Acalyphoideae (Webster, 1994). However, recent phylogenetic studies using DNA sequence data have shown that *Pera* and its close relatives are basal to Rafflesiaceae, plus the balance of Euphorbiaceae s. str. (Wurdack et al., 2005; Wurdack & Davis, 2009). In order to recognize the unique characteristics of Rafflesiaceae while preserving family monophyly, some authors have proposed that *Pera* and its relatives be placed as the Peraceae (Stevens, 2001 onward; Souza & Lorenzi, 2008; Wurdack & Davis, 2009). However, APG III (2009) still does not recognize Peraceae as a true family.

In a revision of the *Pera* species occurring in the Brazilian Amazon based on herbarium vouchers, including types from IAN, INPA, MG, R, RB, SP, UB, and UFMT, and photographs of the types from F, G, IAN, K, L, NY, and P, we found diverse specimens differing from the already described

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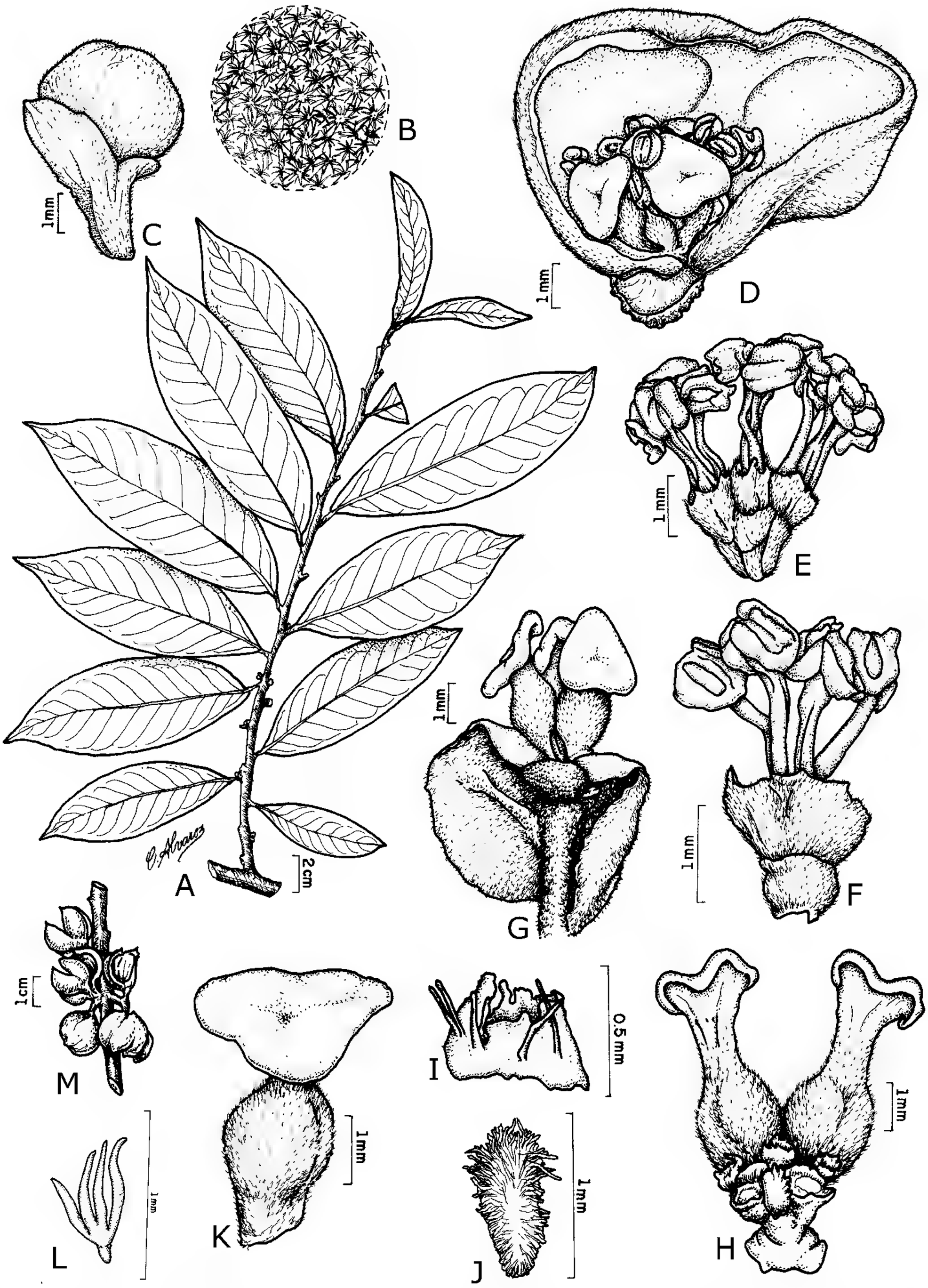

Figure 1. *Pera eiteniorum* Bigio & Secco. —A. Stem with staminate inflorescences. —B. Leaf detail showing the dense indument of stellate trichomes. —C. Immature inflorescence, showing the two bracts present at the base of the involucre. —D. Staminate inflorescence showing involucre completely open at anthesis with the developed, rudimentary pistillate flower. —E. Three staminate flowers with the developed, rudimentary pistillate flower removed. —F. Staminate flower with four stamens, showing the pedicel and the sparse, simple trichomes on the turbinate calyx. —G. Pistillate inflorescence showing the involucre completely open at anthesis and three pistillate flowers. —H. Two of the four pistillate flowers, showing the three basal and rudimentary, sepaloid staminate flowers and the one external, narrowly oblanceolate staminode. —I. Detail of a rudimentary sepaloid staminate flower with sparse, simple trichomes. —J. Detail of a narrowly oblanceolate staminode, with dense indument of stellate trichomes (cf. trichome detail in Fig. 1L), resembling simple trichomes. —K. Pistillate flower with dense indument of

species. This leads to the proposal of a new taxon for the Brazilian Amazon, which is described, illustrated, and discussed below.

Pera eiteniorum Bigio & Secco, sp. nov. TYPE: Brazil. Mato Grosso: Barra do Garças, 254 km along new rd. NNE of village of Xavantina, 6.6 km due S of Base Camp, 12°51′S, 51°45′W, 31 Aug. 1968 (♀ fl., fr.), *G. Eiten & L. T. Eiten 8499* (holotype, SP). Figure 1.

Haec species inter congeneros Brasilae amazonicae quoad folia subcoriacea glandulis patelliformibus abaxialiter carentia, involucrum per anthesin omnino apertum, pseudanthia staminata floribus pistillatis rudimentariis praedita etiam floris pistillati ovarium lageniforme ac stigma integrum *Perae heterantherae* (Schrank) I. M. Johnst. simillima, sed ab ea foliis abaxialiter inter venas indumento denso trichomatum stellatorum ornatis secus costam trichomatibus stellato-lepidotis sparsim vestitis, floris staminati calyce glabro vel raro indumento sericeo trichomatum simplicium sparsis obsito atque floris pistillati staminodio anguste oblanceolato ac stigmate triangulari distinguitur.

Dioecious shrub or tree, ca. 10 m tall, ca. 20 cm diam.; stems covered with stellate-lepidote trichomes when young, becoming glabrous when mature. Leaves alternate, penninerved, 5.5–21 × 1.5–9 cm, lanceolate to elliptic-lanceolate or rarely elliptic, subcoriaceous, margins entire, base cuneate, apex acute to acuminate; adaxial blade surface with stellate trichomes concentrated on the midvein, the remaining blade glabrous or with few stellate trichomes; abaxial blade surface with a dense indument of stellate trichomes, the midvein with sparse stellate-lepidote trichomes, the veins prominent, glands absent; petiole 0.3–1 cm, canaliculate to slightly canaliculate, pilose, with indument of stellate trichomes. Inflorescences either staminate or pistillate in fasciculate pseudanthia, peduncle with lepidote-stellate trichomes, densely grouped, involucre globose before anthesis, completely opened at anthesis, bracteoles 2 at base of involucre, orbicular, opposite, with dense indument of lepidote-stellate trichomes; staminate peduncle 2–4 mm, bracteole ca. 0.5–1 mm diam.; pistillate peduncle 3–5 mm, bracteole 1–1.5 mm diam. Staminate flowers 3 per pseudanthium, pedicels 0.3–0.6 mm, petals absent, calyx turbinate, 5-lobate, the lobules 0.5–0.6 mm, concrescent at base, apex lacerate, glabrous or rarely with sericeous indument of sparse, simple trichomes, stamens 3 or 4 per flower, filaments 2–2.5 mm, connate for 1/2 their length, glabrous, anthers 2–3 mm, rimose, dorsally fixed, with 4 developed rudimentary pistillate flowers, 1.5–2 mm, lageniform, densely tomentose, trichomes stellate, stigma triangular. Pistillate flowers 4 per pseudanthium, subsessile, pedicels ca. 0.2 mm, sepals and petal absent, with 3 rudimentary sepaloid staminate flowers, urceolate, ca. 0.3–0.5 mm, with simple, sparse trichomes and a narrowly oblanceolate staminode, 0.8–1 mm, with a dense indument of stellate trichomes, ovary 1–1.3 mm diam., lageniform (flask-shaped), densely tomentose, trichomes stellate, with 1 ovule per locule, style 0.3–1 mm, stigma entire, triangular, the abaxial surface tomentose, adaxially glabrous, papillose. Fruit 1–1.5 cm diam., globose, mericarps 3, dilated, pilose, trichomes stellate, pedicel 3–5 cm; seeds 6–7 × 4–5 mm, 1 per locule, ovoid, base cuneate, apex roundish, carunculate, caruncle orange, covering 2/3 of seed.

Distribution and habitat. Known from the Brazilian states of Pará, Rondônia, and Mato Grosso, the distribution of *Pera eiteniorum* is concentrated in southwestern Amazonia (Prance, 1994). The taxon is found in transitional areas between cerrado (savanna) and Amazonian forest, occurring also in terra firme forest (never flooded), riparian forest, and capoeira (secondary forest), usually on sandy soils.

IUCN Red List category. *Pera eiteniorum* is assessed here as Least Concern (LC) according to IUCN Red List criteria (IUCN, 2001).

Phenology. Flowering in the new species occurs from September to February, and fruiting takes place from February to October.

Etymology. The specific epithet honors the botanist George Eiten (1923–), who studied in-depth the phytogeography of the Brazilian cerrado. He and his wife, Liene Eiten (1925–1979), were the first to collect the described species in a transition zone between the cerrado and the Amazonian forest.

Common names. *Pera eiteniorum* has been called "caferana" and "feijão de arara" in Mato Grosso State (Bigio, pers. obs.).

Discussion. Based on the involucre being completely open at anthesis, the staminate flowers with well-developed rudimentary pistillate flowers, and the

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stellate trichomes on the ovary (cf. trichome detail in Fig. 1L), resembling simple trichomes. —L. Detail of a stellate trichome as found on the ovary and on the narrowly oblanceolate staminode. —M. Detail of the stem with several fruits. A–C, E drawn from *R. M. Harley & R. Castro 10941* (UB); D, F from *M. N. Ivanuskas 4069* (SP); G from *J. A. Ratter et al. R8088* (UB, UFMT); H–J from *E. S. Lima et al. 149* (SP, UB); and K–M from the holotype *G. Eiten & L. T. Eiten 8499* (SP).

pistillate flowers with an entire stigma, *Pera eiteniorum* must be placed in *Pera* sect. *Spixia* Müll. Arg. In this section, *P. eiteniorum* is morphologically close to *P. heteranthera* (Schrank) I. M. Johnst., but can be distinguished by the stellate trichomes on the abaxial leaf surface; the staminate flowers with the calyx completely glabrous or with sparse, simple trichomes; and the pistillate flowers with a triangular stigma and a narrowly oblanceolate staminode. *Pera eiteniorum* is also morphologically close to *P. membranacea* Leal, also in section *Spixia*, but can be distinguished by the subcoriaceous leaves that lack patelliform glands on the abaxial surface and have a dense indument of stellate trichomes on the abaxial surface, as well as the pistillate flowers with lageniform ovaries and the presence of the staminode. The leaf indument of *P. eiteniorum* is similar to that of *P. tomentosa* (Benth.) Müll. Arg., which is placed in *Pera* sect. *Neopera* Griseb.; however, *P. eiteniorum* has the involucre completely open at anthesis, the staminate flowers with developed, rudimentary pistillate flowers, and the pistillate flowers with an entire stigma. In some species of *Pera*, the stellate trichomes are distributed in clusters and have erect arms, giving the appearance of simple trichomes. This can be observed in *P. eiteniorum* (Fig. 1J, L). Structures such as the rudimentary pistillate and staminate flowers in *Pera* are defined according to Pax and Hoffmann (1919) and Radcliffe-Smith (2001). Details about the main morphological differences among *P. eiteniorum* and related species may be observed in the key.

Paratypes. BRAZIL. **Mato Grosso:** próx. ao Rio Suiazinho, a 290 km NNW de Nova Xavantina, aprox. 12°50′S, 51°53′W, 4 Sep. 1972 (♂ fl.), *J. A. Ratter et al. R2331* (UB); Ribeirão Cascalheira, perto da junção da estrada para Querência com BR-158, aprox. 10 km N de Ribeirão Cascalheira, 12°43′S, 51°53′W, 19 Aug. 1998 (♀ fl., fr.), *J. A. Ratter et al. R8088* (UB, UFMT); Exped. Base Camp, 12°49′S, 51°46′W, 5 Nov. 1968 (fl.), *R. M. Harley et al. 10940* (UB); Exped. Base Camp, 12°49′S, 51°46′W, 5 Nov. 1968 (♂ fl.), *R. M. Harley et al. 10941* (UB); Exped. Base Camp, 5 km ao S, 12°54′S, 51°52′W, próx. rodovia Nova Xavantina a São Felix, 2 May 1968 (fr.), *R. R. de Santos 1245* (UB); Exped. Base Camp, 6 km ao N, 12°54′S, 51°52′W, próximo a rodovia Nova Xavantina a São Felix, 25 Apr. 1968 (fr.), *A. Ferreira et al. 1188* (UB); Ribeirão Cascalheira, estrada ao mpio. Querência, ca. 4.7 km a partir da BR 158, 22 Aug. 1997 (♀ fl.), *E. S. Lima et al. 149* (SP, UB); Sinop próx. entrada para Vera, 7 Nov. 1995 (♂ fl.), *M. Macedo et al. s.n.* (UFMT); Sinop próx. Rio Nandico, 30 May 1995 (fr.), *M. Macedo et al. 4163* (UFMT); Rio Aripuanã, próx. centro Humboldt, descendo do Salto dos Dardanelos, 59°21′S, 10°12′W, 14 Oct. 1973 (fr.), *C. C. Berg et al. P18515* (MG, UFMT); Estação Ecológica Iquê-Juruena, 8 Aug. 1981 (fr.), *G. Guarim-Neto et al. 549* (UFMT); Estr. Xavantina Cachimbo, 5 km W do Km 264 da rodovia, 20 Mar. 1968 (fr.), *D. Philcox et al. 4591* (UB); margem da BR-80, Rod. Xavantina Cachimbo, 10°33′S, 53°44′W, 18 Oct. 1977 (fr.), *B. C. dos Passos 1012* (MG, RB); Pontes de Lacerda 9 km NW de Pontes e Lacerda, BR 364 para Vilhena, 15°10′S, 59°25′W, 31 Oct. 1985 (♂ fl.), *W. Thomas et al. 4735* (MG); Sinop, 3 6 km E of BR 163 on rd. N of Rio Celeste (UFMT 225), 51 km S of Sinop, 12°18′S, 55°34′W, 17 Sep. 1985 (fl.), *W. Thomas et al. 3842* (MG); Gaúcha do Norte, área urbana, 13°10′S, 53°15′W, 13 Aug. 1999 (♂ fl.), *N. M. Ivanuskas 4069* (SP); Dardanelos, Rio Aripuanã, estr. Sta. Helena, 17 June 1974 (fr.), *M. R. Cordeiro 129* (RB). **Pará:** Missão Cururu, 9 May 1977 (♂ fl.) *N. A. Rosa et al. 1863* (MG, RB); Missão Cururu, above Lago dos Ciganos, E of Missão, 7°35′S, 57°31′W, 6 Feb. 1974 (♀ fl., fr.), *W. R. Anderson 10565* (RB). **Rondônia:** cerrado a 21 km de Presid. Médici, margem esquerda da BR 364, 27 Mar. 1986 (♂ fl.), *N. A. Rosa et al. 4997* (MG); Vilhena, 13°43′S, 59°20′W, 17 Apr. 77 (fr.), *s. coll. s.n.* (RB); Pimenta Bueno, margem do Rio Comemoração, 12°02′47″S, 60°37′39″W, 26 Jun. 1998 (fr.), *I. Miranda 2076* (MG).

Key to Species of *Pera* in Amazonian Brazil Morphologically Closely Related to *Pera eiteniorum*

1a. Involucre of the inflorescence opening through a longitudinal aperture at anthesis; the staminate flowers without developed, rudimentary pistillate flowers; pistillate flowers with trifid stigmas... ..... *P. tomentosa*

1b. Involucre of the inflorescence completely opened at anthesis; the staminate flowers with developed, rudimentary pistillate flowers; pistillate flowers with entire stigmas.

2a. Leaves membranous, with patelliform glands on the abaxial blade surface; pistillate flowers with a pyriform ovary and staminodes absent ..... *P. membranacea*

2b. Leaves subcoriaceous to coriaceous, glands absent on the abaxial blade surface; pistillate flowers with a lageniform ovary and staminodes present.

3a. Abaxial leaf surface, including the midvein, with indument of porrect-stellate trichomes; calyx of the staminate flower with ciliate margin of simple trichomes; pistillate flower with an umbraculate stigma and no staminode ..... *P. heteranthera*

3b. Abaxial leaf surface with dense indument of stellate trichomes and with sparse stellate-lepidote trichomes on the midvein; calyx of the staminate flower glabrous or rarely with sericeous indument of sparse, simple trichomes; pistillate flower with a triangular stigma and a narrowly oblanceolate staminode ..... *P. eiteniorum*

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Typification of Neotropical Species of *Staurogyne* (Acanthaceae)

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Abstract. During revisionary work on the genus *Staurogyne* Wall. (Acanthaceae) in the Neotropics, the need for typifications was apparent. Lectotypes are designated for *S. anigozanthus* (Nees) Kuntze, *S. diantheroides* Lindau, *S. elegans* (Nees) Kuntze, *S. hirsuta* (Nees) Kuntze, *S. minarum* (Nees) Kuntze, *S. repens* (Nees) Kuntze, and *S. riedeliana* (Nees) Kuntze. Neotypes are selected for *S. eustachya* Lindau, *S. mandioccana* (Nees) Kuntze, and *S. veronicifolia* (Nees) Kuntze.

Resumo. Durante o estudo de revisão do gênero *Staurogyne* Wall. (Acanthaceae) nos neotrópicos foi verificada a necessidade de tipificações. São designadas lectotipificações para *S. anigozanthus* (Nees) Kuntze, *S. diantheroides* Lindau, *S. elegans* (Nees) Kuntze, *S. hirsuta* (Nees) Kuntze, *S. minarum* (Nees) Kuntze, *S. repens* (Nees) Kuntze e *S. riedeliana* (Nees) Kuntze. São selecionadas neotipificações para *S. eustachya* Lindau, *S. mandioccana* (Nees) Kuntze e *S. veronicifolia* (Nees) Kuntze.

Key words: Acanthaceae, Neotropics, *Staurogyne*.

Staurogyne Wall. (Acanthaceae) comprises approximately 140 species distributed throughout tropical regions of the world (Champluvier, 1991), with ca. 28 occurring in the Neotropics (Braz & Monteiro, 2005). The genus can be distinguished by having a calyx with unequal segments, with one posterior segment larger than the others, one anterior pair of segments intermediate in size, and with one lateral pair smaller than the others. *Staurogyne* is also distinguished by the four, usually didynamous stamens with a reduced staminode between the posterior pair and by the capsules without retinacula and usually with numerous seeds.

The first American species of *Staurogyne* were mainly described in *Flora Brasiliensis* (Nees, 1847a), under the genus *Ebermaiera* Nees in Wall. within the Acanthaceae. Nees described 11 species, the most extensive for the Americas, with many established on syntypes, including more than one taxon, and no illustrations were presented. Kuntze (1891) recognized the name *Staurogyne*, transferring those species treated by Nees (1832, 1847a) in *Ebermaiera*, but without comments. Other taxa and nomenclatural updates were published by Leonard (1937, 1951, 1958). Recent studies on *Staurogyne* have been restricted to their inclusion in local floras (Wasshausen & Smith, 1969; Wasshausen, 1995; Kameyama, 1991, 1995; Profice, 1997) and have included errors in identification. All of this has made the correct identification of Neotropical *Staurogyne* species difficult.

During revision of the American *Staurogyne* species, collections were consulted from the following herbaria: BHCB, BHMH, BM, BOTU, BR, C, CAY, CEN, CEPEC, CESJ, CH, COL, CTES, E, EAC, ESA, ESAL, F, FCAB, FI, GUA, GZU, HB, HRCB, HTO, HUEFS, HUFU, IAN, IBGE, INPA, IPA, K, L, LE, M, MBM, MBML, MG, MO, NY, OUPR, P, PAMG, PEUFR, R, RB, RBR, SI, SP, SPF, U, UB, UEC, UFP, VIC, and W.

I. Staurogyne Wall., Pl. Asiat. Rar. (Wallich) 2: 80, tab. 186. 1831. TYPE: *Staurogyne argentea* Wall. (lectotype designated by Leonard [1951: 5]).

1. Staurogyne anigozanthus (Nees) Kuntze, Revis. Gen. Pl. 2: 497. 1891. Basionym: *Ebermaiera anigozanthus* Nees, Fl. Bras. (Martius) 9: 16–17. 1847. TYPE: Brazil. Minas Gerais: Mun. Ouro Preto, "bracteis lutei floribus flavei-viridis in silvis umbrosis. Montis Itacolomi," Aug. 1824, *L. Riedel 348* (lectotype, designated here, LE; duplicate, GZU 264294).

Discussion. In addition to the lectotype selected here for *Ebermaiera anigozanthus* Nees, the 1847 protologue cited two unnumbered collections, both from Minas Gerais, collected from the municipalities of Mariana and São João Batista. Later in the same

year, Nees (1847b) included material from Martius and four numbered specimens by Riedel (*5*, *10*, *348*, *464* [all at LE]) for *Staurogyne anigozanthus*. Among these, *Martius s.n.* ("ad Praesidium S. Joannis Baptistae, mense Aprili"), *Riedel 10* ("Mariana, Julio 1824"), and *Riedel 348* ("bracteis lutei floribus flavei-viridis in silvis umbrosis. Monte Itacolomi, August 1824") represent the three syntypes cited in the protologue and correspond to the taxon. The remaining collections (*Riedel 5*, *Riedel 464*) better correspond to *S. vauthieriana* (Nees) Kuntze, which are distinguished by their isolated flowers. We here designate *Riedel 348* as lectotype because of its terminal and bracteate raceme with somewhat orbicular and colored bracts, as well as the short corolla, which represents the species very well.

2. Staurogyne diantheroides Lindau, Bull. Herb. Boissier 5(8): 645. 1897. TYPE: Bolivia. [Santa Cruz: José Miguel de Velasco], "200 m alt.," July 1892, *O. Kuntze s.n.* (lectotype, designated here, US 702151; duplicates, GH not seen, NY 278273).

Discussion. Among the type duplicates of *Staurogyne diantheroides* that agree with "Bolivia in prov. Velasco orient. Alt. 200 m (O. Kuntze flor. Julio)," the specimen in the Berlin Herbarium (B) was probably the material analyzed by Lindau (1897), as he was from that institution, and that specimen could therefore be considered the holotype. Before this accession was destroyed in World War II, the sheet was photographed and is now at the Field Museum (F 043983). Because no holotype was mentioned and duplicates of the type are available that well represent the taxon, a lectotype for *S. diantheroides* is designated here. The collections of Otto Kuntze have been incorporated into various United States herbaria (Stafleu & Cowan, 1979), and three duplicates are known from GH, NY, and US. The US collection is chosen as the lectotype because of its good condition.

3. Staurogyne elegans (Nees) Kuntze, Revis. Gen. Pl. 2: 497. 1891. Basionym: *Ebermaiera elegans* Nees, Fl. Bras. (Martius) 9: 17–18. 1847. TYPE: Brazil. Minas Gerais: "ad Vieira do Matto," s.d., *J. B. E. Pohl 3151* (lectotype, designated here, W; duplicates, BR 840386, GZU 251331).

Discussion. In his description of *Ebemaiera elegans*, Nees (1847a: 18) cited three syntypes: from Pohl ("ad Vieira do Matto"), Vauthier ("ad Villam Ricam"), and Riedel ("in sylvis montis Itacolumi, Augusto"). Collection numbers were cited in a later publication (Nees, 1847b: 72) and can be inferred to represent the syntypes (*Pohl 3151*, W; *Vauthier 182*, G; *Riedel 348*, LE). Among the syntypes, only Pohl's collection corresponds to the distinct taxon that we recognize as *Staurogyne elegans*, especially in the leaves 9.5–19 cm long, petiole 0.6–1.8 cm, and corolla 35–47 mm; it is therefore chosen as the lectotype. The remaining syntypes for Nees (1847a) are, in fact, collections of *S. anigozanthus* (*Riedel 348*) and *S. vauthieriana* (*Vauthier 182*). *Staurogyne anigozanthus* is distinguished by its leaves 6.5–16 cm, petioles 0.6–3 cm long, and corolla 24–28 mm; *S. vauthieriana* contrasts with its leaves 9–14.5 cm, petioles 1.1–2.3 cm, and corolla 32–44 mm.

4. Staurogyne eustachya Lindau, Bull. Herb. Boissier 5(8): 644. 1897. TYPE: Brazil. Santa Catarina: Blumenau, Aug. 1884, *C. A. W. Schwacke 206* (neotype, designated here, R 45230).

Discussion. Despite extensive investigation of the herbaria that contain historical collections of *Staurogyne* in the Americas, we were unable to locate the type cited in the protologue for *S. eustachya* (Lindau, 1897: 644, "S^{a} Catarina, prope Blumenau in silva ad terram Schenck n. 193 flor. Setembro"). Johann Heinrich Schenck traveled in Brazil in 1886–1887, and his collections, including the types, were mostly kept at B, where the Acanthaceae collection was totally destroyed during World War II (Stafleu & Cowan, 1985). Therefore, we propose as the neotype of *S. eustachya* the collection *Schwacke 206*, housed in the Herbarium of the National Museum of Rio de Janeiro (R). This specimen well represents *S. eustachya*, including the terminal and pedunculate spike with the floriferous region notably segregate, the viscid-pubescent rachis, the oblong bracts, and the size of the calyx and corolla, among other attributes cited by Lindau (1897) in the description of the species. Furthermore, the collection is from the same general locality as the original type.

5. Staurogyne hirsuta (Nees) Kuntze, Revis. Gen. Pl. 2: 497. 1891. Basionym: *Ebermaiera hirsuta* Nees, Fl. Bras. (Martius) 9: 18. 1847. TYPE: Brasil. Minas Gerais: "Tejuco," 1883, *Vauthier 239* (lectotype, designated here, P; duplicate, GZU 251310).

Discussion. *Staurogyne hirsuta* was described from the state of Minas Gerais and circumscribed by the hirsute-tomentose stem, the lanceolate leaf blade, and the terminal and sessile raceme, among other characters. The collections *Schüch s.n.* and

Vauthier s.n. were the syntypes cited in its protologue (Nees, 1947a), all collected in the same locality ("Tejuco in prov. Minarum Generalium: Vauthier, Schüch"). Later, Nees numbered *Vauthier 183* and *Vauthier 239* in addition to *Schüch s.n.* (Nees, 1847b). In the Herbarium of the Naturhistorisches Museum Wien (W), in addition to the collection *Vauthier 183*, there is an unnumbered exsiccata of *S. hirsuta* collected by Schüch; however, we avoided proposing unnumbered materials of Schüch as type material because the lack of numbering introduces confusion and because they have been cited as types for a number of other taxa. The Paris collection *Vauthier 239* is here designated as the lectotype based on its copious material.

6. Staurogyne mandioccana (Nees) Kuntze, Revis. Gen. Pl. 2: 497. 1891. Basionym: *Ebermaiera mandioccana* Nees, Pl. Asiat. Rar. (Wallich) 3: 80. 1832. TYPE: Brazil. Rio de Janeiro, s.d., *L. Riedel 797* (neotype, designated here, LE).

Discussion. According to Stafleu and Cowan (1976), the protologue collections of Beyrich from Brazil, dating from 1822 to 1823, were distributed in many herbaria. The cited holotype (Nees, 1832: 80, "in Mandiocca ad margines sylvarum mense Augusti a. 1822, cum floribus fructuque maturo legit Beyrichius"), collected in the state of Rio de Janeiro, has not been found and, except for the original description, has not been cited elsewhere. This type could possibly have been deposited at B, and therefore destroyed before updated studies on the genus in the 20th century (Leonard, 1951, 1958; Wasshausen & Smith, 1969; Kameyama, 1991). Nees (1847a: 16, 1847b: 71) later mentioned the collections of *Pohl 4740*, *Pohl s.n.* ("prope Rio de Janeiro"), and *Riedel 797* ("in silvis Macahe"), in addition to the earlier cited holotype. The collections of Pohl (*Pohl 4747*, W, "prope Rio de Janeiro") and of Riedel (*Riedel 797*, LE, "in silvis Macahe") both correspond to *Staurogyne mandioccana*. As the holotype is missing, the specimen *Riedel 797*, which consists of plentiful material and conforms to the protologue in its glabrous leaves, terminal and axillary inflorescences, and spatulate bracts, is here designated as the neotype of *S. mandioccana*.

7. Staurogyne minarum (Nees) Kuntze, Revis. Gen. Pl. 2: 497. 1891. Basionym: *Ebermaiera minarum* Nees, Fl. Bras. (Martius) 9: 17. 1847. TYPE: Brazil. Minas Gerais, Sep. 1841, *G. Gardner 5129* (lectotype, designated here, W; duplicates, BM, E, FI, K, P, R).

Discussion. In the description of *Staurogyne minarum* (Nees, 1847a), the collections *Martius 943*, *Ackermann s.n.*, *Schüch s.n.*, *Gardner 5129*, *Sellow s.n.*, and *Riedel s.n.* were cited and are syntypes. Nees (1847b: 71) subsequently included the herbaria and collection numbers as *Martius 943* (M), *Sellow 151*, *210*, *253* (B), and *Riedel 6*, *467* (LE), as well as the herbaria for the remaining syntypes. Analyses of these specimens reveal that the collections *Martius 943*, *Gardner 5129*, and *Sellow 253* (B, duplicate at K) represent *S. minarum* based on the terminal lax raceme. The other Sellow syntypes were not found, and the collections *Ackermann s.n.*, *Schüch s.n.*, and *Riedel 6* and *467* correspond to other taxa. Furthermore, the herbarium sheet for *Martius 943* includes notations on the label with the names *Ebermaiera minarum* Nees and *Poecilocnemis minarum* Mart.; this latter name has been cited in the descriptions of Nees (1847a, 1847b) but has not been cited elsewhere. The collection *Gardner 5129* is here designated as lectotype because it is morphologically representative and has duplicates in other herbaria (BM, E, FI, K, P, and R) that consist of copious material.

8. Staurogyne repens (Nees) Kuntze, Revis. Gen. Pl. 2: 497. 1891. Basionym: *Ebermaiera repens* Nees, Fl. Bras. (Martius) 9: 20. 1847. TYPE: Brazil. Mato Grosso: Mun. Cuiabá, June 1827, *L. Riedel 1087* (lectotype, designated here, LE).

Discussion. *Staurogyne repens* (Nees, 1847a: 20) was described based on two types collected by Riedel in the state of Mato Grosso, one in Cuiabá and the other in "Serra da Chapada." Nees (1847b) later cited the numbers for three Riedel collections (all at LE) for this species, two of which (*Riedel 1* and *1087*) are clearly individuals of *S. repens*, especially with regard to the prostrate habit and the lanceolate-ovate leaves (0.9–5.3 × 0.3–0.7 cm). Both of these collections are grouped with the exsiccata of another species, *S. miqueliana* Kuntze (*Riedel 15*), which can be differentiated from *S. repens* by its erect habit and elliptic leaves (0.9–2.3 × 0.3–1.2 cm). The specimen *Riedel 1087* is here designated as the lectotype of *S. repens* based on its good condition.

9. Staurogyne riedeliana (Nees) Kuntze, Revis. Gen. Pl. 2: 497. 1891. Basionym: *Ebermaiera riedeliana* Nees, Fl. Bras. (Martius) 9: 18–19. 1847. TYPE: Brazil. Rio de Janeiro, s.d., *L. Riedel 47* (lectotype, designated here, LE).

Discussion. *Staurogyne riedeliana* has as syntypes the collections *Riedel 47* (LE), from the state of

Rio de Janeiro, and *Riedel 0,16* (LE), from the state of Bahia, both of which were cited as the variety *salicifolia* by Nees (actually corresponding to the type variety), as well as *Riedel 0,70* (LE), also from Rio de Janeiro, which corresponds to the variety *latifolia*. *Riedel 47* characterizes the species very well, especially with regard to leaf form (elliptic to lanceolate-ovate); the short, terminal, and sessile spikes; and the large bracts that are bigger than the flowers, and it is designated here as the lectotype of *S. riedeliana*.

10. Staurogyne veronicifolia (Nees) Kuntze, Revis. Gen. Pl. 2: 497. 1891. Basionym: *Ebermaiera veronicifolia* Nees, Fl. Bras. (Martius) 9: 18. 1847. TYPE: Brazil. Espírito Santo: Alfredo Chaves, São Bento de Urânia, 8 Oct. 1994, *G. Hatschbach 61140 & J. M. Silva* (neotype, designated here, MBM).

Discussion. The original type of *Staurogyne veronicifolia* was a Sellow collection from southern Brazil and was known to be deposited at B. The holotype was destroyed during World War II, and no extant type material has been found, hence a neotype of *S. veronicifolia* is proposed herein. Considering the diagnostic features in the description, especially the short petiole, the elliptic to elliptic-ovate leaves (1.7–4.1 cm long), the terminal capitate inflorescence, and the bracts, calyx, and corolla that are nearly the same length, with the bracts slightly longer and ovate, the collection *G. Hatschbach 61140 & J. M. Silva* (MBM) is designated here as the neotype of *S. veronicifolia*. *Staurogyne veronicifolia* appears to be restricted to the state of Espírito Santo in Brazil.

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A New Species of *Cohniella* (Orchidaceae, Cymbideae, Oncidiinae) from Amazonian Venezuela

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ABSTRACT. A new species was detected while conducting a monographic study of *Cohniella* Pfitzer (Orchidaceae, Cymbideae, Oncidiinae). *Cohniella croizatii* Cetzal & Carnevali is newly described from material collected in the vicinity of Puerto Ayacucho and from the upper Orinoco, Amazonas State, Venezuela. The new species is illustrated and its affinities are discussed. The novelty is similar to *C. cebolleta* (Jacq.) Christenson from northern Venezuela and Colombia, but differs in the callus that consists of three large, apical teeth of more or less similar size that emerge directly from the labellum disk, with the two lateral teeth marginally serrate to dentate on the proximal half. In contrast, the callus in *C. cebolleta* is more complex, consisting of five teeth that emerge from a conspicuous central platform, and the central tooth is proportionately larger.

RESUMEN. Una especie nueva fue encontrada durante nuestro trabajo monográfico en el género *Cohniella* Pfitzer (Orchidaceae, Cymbideae, Oncidiinae). *Cohniella croizatii* Cetzal & Carnevali se propone como nueva de Puerto Ayacucho y del Alto Orinoco del Estado Amazonas, Venezuela. Esta especie nueva es ilustrada y sus afinidades son discutidas. La novedad está relacionada con *C. cebolleta* (Jacq.) Christenson del norte de Venezuela y Colombia, pero difiere por el callo que consiste de tres dientes apicales más o menos del mismo tamaño que emergen directamente del disco del labelo, los dos dientes laterales son marginalmente serrados a dentados en la mitad proximal. Por el contrario, mientras que el callo en *C. cebolleta* es más complejo, consistiendo de cinco quillas que emergen de una plataforma central conspicua, y el diente central es proporcionalmente muy grande.

Key words: Amazonas, *Cohniella*, IUCN Red List, Oncidiinae, Orchidaceae, Venezuela.

The genus *Cohniella* Pfitzer consists of 17 described species that are distributed from northern Mexico into southern Brazil and northern Argentina. The members of this orchid genus can be easily distinguished from other members of the Oncidiinae by their succulent, terete leaves and *Oncidium*-like flowers (Carnevali et al., 2010). Characters used to distinguish species are mainly floral, such as the shape and position of the basal lobes of the lip, the shape and number of teeth of the callus of the lip, and the column shape and position of the column wings. Additionally, we have used diagnostic elements for species-level taxa that consider the size and orientation of the plants (e.g., pendent or erect), leaf thickness, the relative sizes of pseudobulbs, ecological preferences, and geographic distribution (Cetzal & Carnevali, 2010).

Since its resurrection by Christenson (1999), the generic status of *Cohniella* as distinct from *Oncidium*, as well as from a broadly circumscribed *Trichocentrum* Poepp. & Endl., has been controversial. As opposed to other authors (Sandoval-Zapotitla & Terrazas, 2001; Sosa et al., 2001; Williams et al., 2001a, 2001b; Chase, 2009) who have treated members of *Cohniella*, *Lophiaris* Raf., *Lophiarella* Szlach., Mytnik & Romowicz, and *Trichocentrum* s. str. as belonging to a single genus (*Trichocentrum* s.l.), we describe this new taxon in the genus *Cohniella*. Below, we offer a key to the genera of the *Trichocentrum* clade, based upon both vegetative and floral traits. The rationale behind this narrower generic circumscription is discussed in depth elsewhere (Pupulin & Carnevali, 2005; Cetzal et al., 2008; Carnevali et al., 2009, 2010). Our treatment recognizes more, easily diagnosable, monophyletic entities rather than larger, polymorphic generic units that may be unwieldy or difficult to define.

Key to the Genera of the *Trichocentrum* Clade

1a. Leaves terete, fleshy-coriaceous; pseudobulbs relatively small and inconspicuous ..... *Cohniella*
1b. Leaves conduplicate, either rigidly fleshy or coriaceous; pseudobulbs ranging from small and inconspicuous to relatively large and conspicuous.
  2a. Plants small (leaves rarely exceeding 10 cm long); inflorescences shorter than the subtending leaves, mature plants bearing few (1 to 3[to 5]), successive flowers; labellum basally produced into a spur .... *Trichocentrum*
  2b. Plants usually larger (leaves usually exceeding 12 cm long; however, they may be smaller in *Lophiaris pumila* (Lindl.) Braem and relatives, but these flowers lack a spur); inflorescences usually longer than subtending leaves (shorter in *L. pumila* and relatives), mature plants bearing many ([5 to]10 to 50[to 150]), ± simultaneous, rarely successive (e.g., *L. lindenii* (Brongn.) Braem) flowers; labellum lacking a spur.
    3a. Leaves rigidly and thickly fleshy-coriaceous; pseudobulbs large and conspicuous, at least 2 cm long, but up to 4 cm long; inflorescences stiffly erect, peduncle and rachis glaucous, with a thin film of wax; plants usually lithophytic ..... *Lophiarella*
    3b. Leaves coriaceous or fleshy-coriaceous, rarely rigid; pseudobulbs small, rarely exceeding 1.5 cm long; inflorescences more commonly ascendent or arching to nutant, never stiffly erect; peduncle and rachis not glaucous; plants usually epiphytic, rarely lithophytic ..... *Lophiaris*

During the course of preparing a monographic study of *Cohniella* (Cetzal et al., in prep.), a hitherto unknown taxon was detected. The new species is closely related to, yet geographically disjunct from *C. cebolleta* (Jacq.) Christenson. *Cohniella cebolleta* is known from northern Venezuela and Colombia and grows in drier environments, typically tropical dry forest or thorn forests. The novelty proposed here, *C. croizatii* Cetzal & Carnevali, is known from two Venezuelan populations, one from Puerto Ayacucho in northern Amazonas State, where the plants grow in tropical rainforests, and the second collection from the upper Orinoco in the southern portion of the Amazonas State. At this second locality, the plants grew in Amazonian rainforests on white sand substrates.

The most distinctive feature of the new species is the callus. In most *Cohniella* species, the callus is an extremely complex structure. It is conventionally composed of a variously shaped basal platform from which two or four lateral teeth emerge, and the platform terminates in a much larger apical tooth or keel (Fig. 1A). In contrast, in the new species, the callus is composed of three large apical teeth of about the same size that emerge directly from the labellum disk. The two lateral teeth are separated by a narrow channel and are marginally serrate to dentate on their proximal half (Fig. 1B, H).

Cohniella croizatii Cetzal & Carnevali, sp. nov. TYPE: Venezuela. Amazonas: Mpio. Alto Orinoco, 1951, *L. Croizat 984* (holotype, NY; isotype, CICY [fragm.]). Figure 1.

Species haec *Cohniellae cebolletae* (Jacq.) Christenson similis, sed ab ea callo minore tridentato e dentibus lateralibus margine proximaliter pauce serrato-dentatis et apicali lateraliter compresso dentes laterales subaequante constante differt.

Epiphytic erect herbs; rhizome short, thin, brittle; roots ca. 2 mm thick, white; pseudobulbs ca. 8 × 9 mm, subspherical to broadly ovoid. Apically 1-leaved, green, totally enclosed by 3 imbricate sheaths, 30–70 × 5–10 mm, eventually deciduous; leaves terete, thickly fleshy-coriaceous, 23–37.2 cm × 4–6 mm, dark green; inflorescences solitary from the base of the pseudobulbs, 63–123 cm, a 10- to 15-flowered raceme or panicle with 3 to 4 long branches, each of these 3.6–10 cm, the branches 3- to 4-flowered; peduncle and rachis dark green with brownish spots; peduncle ± erect, 2–4 mm thick, terete, with 8 to 13 remotely bracted internodes, the basal and apical bracts equally long, oblanceolate, acuminate, tubular; floral bracts 2–3 mm, narrowly elliptic, acuminate. Flowers resupinate, with perianth segments widely opening, the petals and sepals somewhat reflexed; ovary with pedicel 15–20 mm, of which ca. 4–7 mm correspond to the ovary, this structure 0.4–0.8 mm thick; sepals basally clawed for about 1/3 their total length, flat or somewhat reflexed, dorsal sepal 6.5–7 × 4–5 mm, in general outline obovate, apically obtuse and minutely apiculate, concave in the upper half, the claw ca. 2 × 1 mm; lateral sepals partially fused at the very base, then free, similar to dorsal sepal, 8–9 × 4–5 mm; petals 7–8 × 3–4 mm, oblong, somewhat oblique, the apex subacute, somewhat reflexed in natural position; labellum deeply 3-lobed, 9–13 mm from the base to the apex of the central lobe, 12–15 mm wide across the apices of the lateral lobes, the lateral lobes in the same plane as the central lobe and ± perpendicular to it; central lobe (6–)9–12 × (11–)17–21 mm, transversely elliptic or subreniform in outline, apically rounded, deeply emarginate, (2–)3–4 mm, basally produced into a short isthmus, ca. 2.5 × 3 mm; lateral lobes 5–6 × 3–5 mm, ± oblong to orbicular, obliquely obtuse; disc short, ca. 4 × 4 mm; callus with 3 large apical teeth, similarly sized, emerging directly from the labellum disk, the 2 lateral teeth separated by a narrow channel and marginally serrate to dentate on the proximal half, ca. 2.8 × 0.6 mm, the central tooth is laterally compressed, ± equally sized to the lateral teeth, ca. 2 × 0.6 mm;

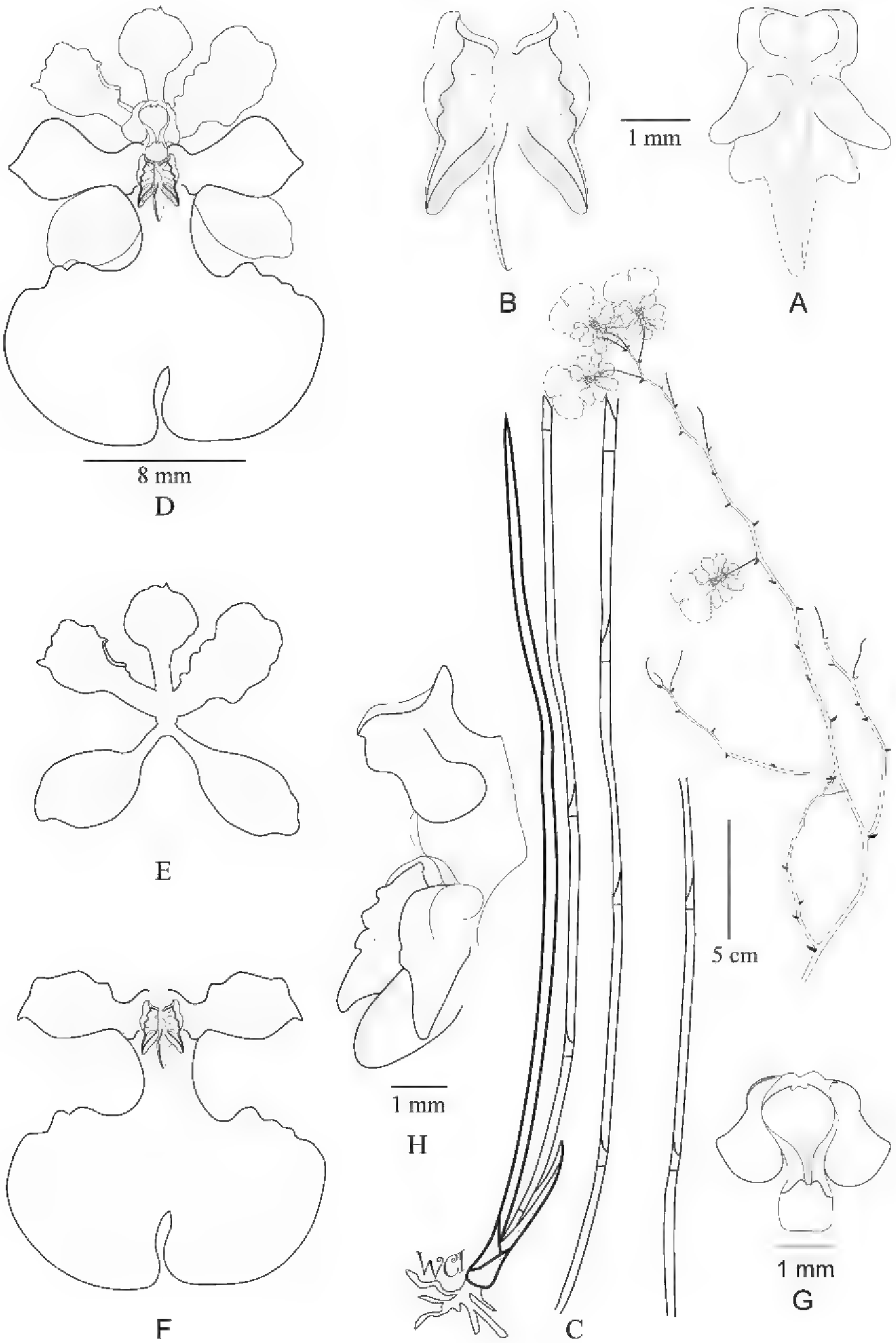

Figure 1. —A. A complex callus of *Cohniella cebolleta* (Jacq.) Christenson, based on *G. Carnevali 7222* (CICY). B–H. *Cohniella croizatii* Cetzal & Carnevali. —B. A simpler callus. —C. Habit with inflorescence. —D. Intact flower. —E. Sepals (above) and petals (below). —F. Labellum. —G. Column. —H. Lateral view of the callus and column. B–H based on the type *L. Croizat 984* (NY).

column ca. 3 × 1 mm, ± oblong, the ventral face longitudinally convex, stigmatic surface obovate, ca. 1 × 0.8 mm; column wings ca. 1.8 × 0.8 mm, asymmetrically bilobed with the apical lobe slightly smaller; anther ca. 0.9 × 0.7 mm, apical, operculate, ellipsoid; pollinarium ca. 1.2 mm, tegula spatulate, ca. 0.6 × 0.3 mm at the subtruncate apex; viscidium disclike, small, pollinia 0.7–0.9 mm; fruit a capsule.

Distribution. The new species is known from two collections from Puerto Ayacucho as well as the type collection of the upper Orinoco in Amazonas State, Venezuela. The labels of the specimens from the Puerto Ayacucho area describe the plants as locally common along the Orinoco.

IUCN Red List category. Because *Cohniella croizatii* is known from only three collections, it can be considered Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001). Although the region around Puerto Ayacucho has been severely altered during the past few decades, there are still abundant forested patches in the area. Furthermore, since the species is also known from the Alto Orinoco region, it is therefore suspected to be under no special threat, as this area is largely uninhabited except for a few indigenous tribes, primarily Yekuana.

Etymology. The new species honors León Camille Marius Croizat (1894–1982), collector of the type specimen. Croizat contributed enormously to our knowledge of the Euphorbiaceae and also originated the theory of panbiogeography.

Diagnostic features. *Cohniella croizatii* seems to be a rather homogeneous taxon. It is easy to distinguish from related species by its small tripartite callus (vs. 5-partite), consisting of one laterally compressed central tooth or keel that is similar to the lateral teeth (ca. 2 mm vs. ca. 2.8 mm long, respectively). The two lateral teeth are separated by a narrow channel and are marginally serrate to dentate along their proximal half. The column wings in *C. croizatii* seem to be proportionally larger than in *C. cebolleta*, but the available herbarium material is not sufficient to assess this accurately. Because *Cohniella* species usually differ from each other in several floral characters, including color, column width and shape, and the relative positions of the floral parts, we anticipate that fresh material of the new species will reveal further differentiating characters lost during specimen preparation. Otherwise, *C. croizatii* is easily diagnosable by its simple callus.

Paratypes. VENEZUELA. **Amazonas:** Puerto Ayancho [Ayacucho] on Orinoco River, [grown at New York Bot. Gard.], 50 ft., 1 Jan. 1961, *Prop. 1270/59* (NY); Raudal de Atures, 10 km S of Pto. Ayacucho, 100–120 m, 10 Nov. 1953, *B. Maguire, J. J. Wurdack & G. S. Bunting 36131* (AMES, NY).

Acknowledgments. We are indebted to the curators of AMES and NY for allowing us to study their material for our work on this article. We are further grateful to the curator of NY who gave permission for a fragment of the type to be deposited at CICY. The senior author thanks the Centro de Investigación Científica de Yucatán for its support during this research and the Consejo Nacional de Ciencia y Tecnología (CONACyT) for financial support (scholarship no. 162579). CONACyT partially funded this project via grant 49980-Q, awarded to the junior author. Sergio Salazar Vallejo (ECOSUR) and Rodrigo Duno (CICY) read earlier versions of this paper, for which we are deeply indebted. Silvia Hernández-Aguilar (CICY) helped with herbarium specimen handling. Finally, we are indebted to N. H. Williams and two anonymous referees for valuable comments.

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A New Name for *Papaver pseudo-orientale* (Papaveraceae)

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Abstract. The new name *Papaver setiferum* Goldblatt (Papaveraceae) is proposed for *P. pseudo-orientale* (Fedde) Medw. (1918), which is a homonym for a plant of that name coined by E. G. Camus in 1898 for the hybrid *P. orientale* L. × *P. lateritium* K. Koch, described in detail but not named by J. R. Jungner in 1889.

Key words: Armenia, Georgia, Iran, *Papaver*, Papaveraceae, Turkey.

In my study of the biosystematics of the Middle Eastern *Papaver* L. sect. *Oxytona* Bernh. (Goldblatt, 1974), I recognized three species: diploid *P. bracteatum* Lindl., tetraploid *P. orientale* L., and hexaploid *P. pseudo-orientale* (Fedde) Medw., the latter based on *P. bracteatum* var. *pseudo-orientale* Fedde (Fedde, 1909), a plant of Armenia, Georgia, Iran, and Turkey (Popov, 1970; Goldblatt, 1974).

An earlier homonym for the species name has now come to my attention, *Papaver* ×*pseudo-orientale* E. G. Camus (Camus, 1898). Camus provided the epithet for the hybrid taxon from the parentage of *P. orientale* L. × *P. lateritium* K. Koch, described in some detail by Jungner (1889), but not accorded a specific name. Although the epithet was applied to an avowed hybrid, it is valid and must be taken into account for nomenclatural consideration (McNeill et al., 2006: Art. H.3.3, Ex. 2). *Papaver pseudo-orientale* (Fedde) Medw. has no valid synonyms, and a new name for the species is thus necessary and is provided below.

Papaver setiferum Goldblatt, nom. nov. Replaced synonym: *Papaver pseudo-orientale* (Fedde) Medw., Isv. Kavkazsk. Muz. [Bull. Mus. Cauc.] 11: 207. 1918, nom. illeg., non *Papaver* ×*pseudo-orientale* E. G. Camus, J. Bot. (Morot) 12(10): 156. 1898. TYPE: Turkey. "Szandschack Gumuschkane," *P. E. E. Sintenis 5989* (lectotype, designated by Goldblatt [1974: 292], B).

Acknowledgments. I thank Ulf Eliasson for drawing my attention to the existence of the name *Papaver* ×*pseudo-orientale* E. G. Camus.

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Convolvulaceae Neotropicae Novae vel Minus Cognitae, I. *Bonamia jiviorum*, a New Species from the Venezuelan Guayana

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ABSTRACT. The new species *Bonamia jiviorum* J. R. Grande (Convolvuloideae, Cresseae) is described and illustrated from northwestern Amazonas in Venezuela. This new taxon is morphologically similar to *B. apurensis* D. F. Austin. It is characterized by its relatively small, ovate-orbicular leaves that are densely rough-tomentulose over both surfaces and have a truncate to subcordate base and rounded to obtuse, mucronulate or minutely retuse apex; relatively lax, aphyllous infructescences with relatively short peduncles and relatively short, adpressed bracts; orbicular sepals; glabrous fruits crowned by copper-colored setose hairs; and densely pustulate, irregularly striate, conspicuously winged seeds. *Bonamia jiviorum* is known only from the vicinity of Puerto Ayacucho, over low-altitude granitic boulders known locally as lajas.

RESUMEN. Se describe e ilustra *Bonamia jiviorum* J. R. Grande (Convolvuloideae, Cresseae) del noroccidente del estado Amazonas de Venezuela. Esta nueva especie es morfológicamente afín a *B. apurensis* D. F. Austin y se caracteriza por presentar láminas foliares relativamente pequeñas, ovado-orbiculares, truncadas hasta subcordadas en la base, redondeadas hasta obtusas, mucronuladas ó retusas en el ápice, con pubescencia densa, áspero-tomentulosa, por ambas caras; inflorescencias áfilas, relativamente laxas, con pedúnculos relativamente cortos y brácteas adpresas relativamente cortas; sépalos orbiculares; frutos coronados por un mechón de pelos setosos cobrizos, del resto glabros; y semillas con superficie densamente pustulada e irregularmente estriada, con alas sobre las aristas laterales alcanzando los 0.2 mm de largo. *Bonamia jiviorum* sólo se conoce de los alrededores de la ciudad de Puerto Ayacucho, donde se encuentra creciendo sobre afloramientos graníticos de baja altitud conocidos localmente como lajas.

Key words: Amazonas, *Bonamia*, Convolvulaceae, Convolvuloideae, IUCN Red List, Venezuela.

According to the most recent revision (Myint & Ward, 1968), *Bonamia* Thouars (Convolvuloideae, Cresseae) contains 45 species in three sections (*Bonamia* sect. *Bonamia*, *Bonamia* sect. *Breweria* (R. Br.) Myint, and *Bonamia* sect. *Trichantha* Myint) distributed through the Old and New World tropics and subtropics. Sections *Trichantha* (13 species) and *Breweria* (seven species) are restricted to South America and Australia, respectively, whereas section *Bonamia* (25 species) is pantropical (Myint & Ward, 1968). Species in section *Bonamia* can be differentiated from those of section *Trichantha* by the seeds being glabrous rather than comose; those of section *Breweria* are distinguished by the multiflowered inflorescences (vs. simple or few-flowered) that are longer than 5 mm not including the flowers, by the corollas 1.8 cm long or more, and the leaves 3 cm long or more (Myint & Ward, 1968). Species of *Bonamia* have no economic importance, although some of them could be cultivated as ornamentals.

Many species of the genus *Bonamia* are known only from one or a few specimens from one locality or region (Myint & Ward, 1968). That characteristic, together with its apparent Gondwanan pattern of distribution (shown even in some of its more natural groups, e.g., section *Bonamia*), makes this genus, despite its apparent polyphyletic nature (Stefanović et al., 2002, 2003), an excellent study object in historical biogeography and speciation. Considering the relatively high number of species that have been described or transferred since the publication of the last comprehensive revision of the genus (Long, 1970; Austin, 1982, 1994; Austin & Staples, 1985; Johnson, 1987; McDonald, 1987; Gentry, 1988 [1989]; Breteler, 1992; Deroin, 1992 [1993], 1998, 2004), as well as other important changes in the family's classification (Stefanović et al., 2002, 2003), a new worldwide taxonomic revision of the genus should be done, in which a cladistic treatment of its species should be included. As a result of the taxonomic investigation of material deposited in some

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herbaria of Venezuela, the description of a new species in *Bonamia* sect. *Bonamia* is offered here.

Bonamia jiviorum J. R. Grande, sp. nov. TYPE: Venezuela. Amazonas: Dpto. Atures, cuenca del río Cataniapo, tramo carretera desde el Aeropuerto de Puerto Ayacucho hasta la entrada a la comun. Las Pavas, en la vía a Gavilán, SE de esta capital, 5°32′–5°40′N, 67°25′–67°36′W, 19 Feb. 1982, *F. Guanchez 1551* (holotype, VEN 363556; isotype, TFAV not seen). Figure 1.

Haec species *Bonamiae apurensi* D. F. Austin proxima, sed ab ea caule foliis (utrinque) inflorescentia sepalisque trichomatibus in sicco cupreo-ochraceis dense aspero-tomentosis, laminis foliaribus ovato-orbiculatis 3.8 5.6 cm longis 3.1 4.5 cm latis, pedunculo 2.3 4 cm longo, bracteis infructescentiae adpressis inconspicuis ex anguste triangulari deltoideis 1 3 mm longis, sepalis orbicularibus 6 6.5 mm longis 5 6 mm latis apice rotundatis, fructibus valvis plerumque glabris apice trichomatibus densis ca. 1 mm longis barbatis atque seminibus irregulariter striatis margine alatis alis rubicundis ca. 0.2 mm latis differt.

Scandent herbs, copper-ochraceous when dry; simple and bifid, recurved, 0.3–0.5 mm trichomes with tuberculate base forming a dense, rough-tomentulose pubescence over stems, leaves (both surfaces), inflorescences, and sepals; stems twining. Leaves simple, alternate; petioles 1.6–2 cm; leaf blades ovate-orbicular, slightly asymmetric, truncate to subcordate at the base, rounded to obtuse, mucronulate or minutely retuse at the apex, 3.8–5.6 × 3.1–4.5 cm, primary and secondary nerves obscure, tertiary venation not distinguishable on either surface. Inflorescences dichasial, axillary, simple or paired, known only in fructification, 4.5–5.4 × 1.5–3.5 cm (excluding fruits), relatively lax, 2× to 4× ramified; peduncles 2.3–4 cm; pedicels 0.6–1.3 cm; inflorescence bracts adpressed, inconspicuous, those subtending the primary branches narrowly triangular and ca. 3 mm, those subtending the fruits deltoid and ca. 1 mm. Flowers not seen. Calyx (in fructification) with orbicular sepals of 6–6.5 × 5–6 mm, rounded at the apex. Fruits globose, ca. 1 × 0.8 cm, 4-valved, septicidally dehiscent; valves glabrous, stramineous, with a beard of copper-colored trichomes of ca. 1 mm at the apex. Seeds one per locule, trigonous, black, ca. 4 × 3.8 mm, the surface densely pustulate and irregularly striate, the lateral edges winged; seed wings reddish, ca. 0.2 mm.

Distribution and habitat. The new species is known only from the type specimen, collected on granitic outcrops or boulders (known locally as lajas) of northwestern Amazonas State (Venezuela), in the environs of the city of Puerto Ayacucho. Based on the type collector's field notes, *Bonamia jiviorum* was a twining herb with shiny olive-green fruits, with abundant fructification in February 1982, and was frequent within open areas at the type locality.

IUCN Red List category. *Bonamia jiviorum* is assessed here as Data Deficient (DD), according to IUCN Red List criteria (IUCN, 2001). The potential range of this species, however, is subject to periodic fires and has been studied for the extraction of granite slabs (O. Huber, pers. comm.) and coltan, the so-called "blue gold" whose reserves in Venezuela could reach $100,000 million (Tillett et al., 2011).

Etymology. The epithet *jiviorum* is noteworthy for recognizing the contribution of the Jivi people in Venezuela. This is the first such instance in a plant name (IPNI, 2011). The epithet means, in the Latin, "of the Jivi." The Jivi are one of the aboriginal groups inhabiting the city of Puerto Ayacucho and the savannas of its environs, extending westward along the Meta and Arauca rivers. In the Jivi language, Jivi means "people."

Discussion. *Bonamia jiviorum* is easily distinguished from similar species by its ovate-orbicular leaves with a rounded to obtuse, mucronulate or minutely retuse apex, the densely rough-tomentulose pubescence over both leaf surfaces, obscure leaf veins (only primary and secondary distinguishable), and by its axillary, short-pedunculate inflorescences that bear inconspicuous, adpressed bracts. This new species seems to be most closely related to *B. apurensis* D. F. Austin, from which it can be distinguished by the characters listed in Table 1. In addition, the infructescences of *B. jiviorum* are aphyllous (vs. foliate) and somewhat more lax, and the seeds are somewhat smaller. According to Austin (1998), *B. apurensis* has been reported for western Venezuela and Colombia, overlapping in the eastern extreme of its distribution with the new species. One specimen labeled as *B. apurensis* (*G. Aymard & R. Thimann 713*, MO not seen, PORT), however, corresponds to *B. trichantha* Hallier f., which is the most commonly seen *Bonamia* species from western Venezuela.

Bonamia jiviorum is the only species in the genus *Bonamia* that is known to be endemic to Venezuela. It is also a characteristic element of the transitional zone between the Llanos Region (Caribbean region) and the Guaniamo–Guayapo District of the Guayana Region (Berry et al., 1995), together with *B. holtii* O'Donell, a morphologically very different species. It can be readily distinguished from other Venezuelan members of the genus (i.e., those reported in Austin [1982, 1998], and Tapia [2008]) by its ovate-

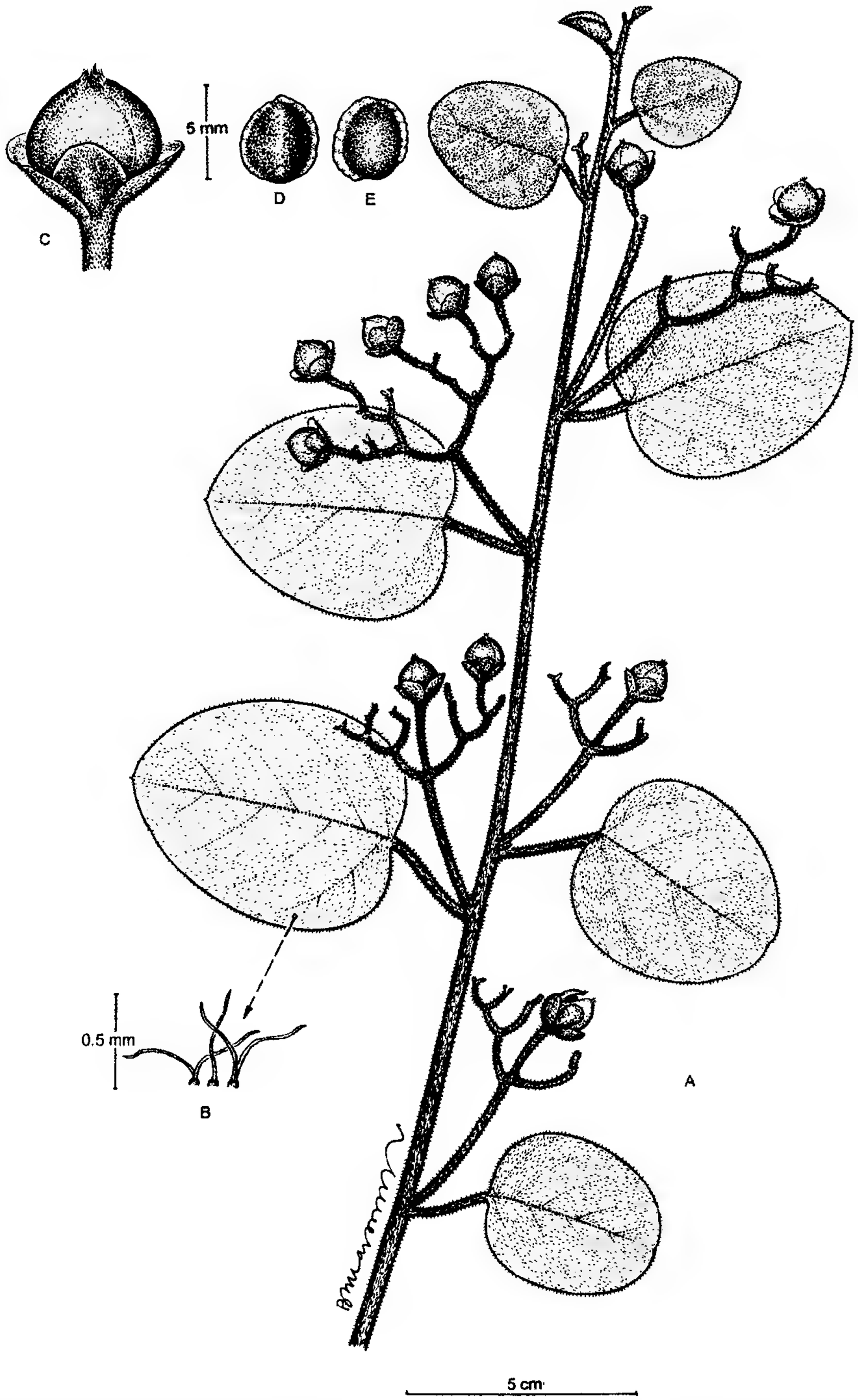

Figure 1. *Bonamia jiviorum* J. R. Grande. —A. Plant. —B. Plant trichomes. —C. Fruit. —D. Seed, ventral surface. —E. Seed, dorsal surface. A–E drawn from the holotype, *Guanchez 1551* (VEN).

orbicular leaves densely covered with a rough-tomentulose pubescence over both surfaces. Despite the lack of flowers in the available material, this new species is attributable to *Bonamia* based on its bifid trichomes (Hallier, 1893; Myint & Ward, 1968); the 4-valved, septicidally dehiscent, 4-seeded (one seed per locule) fruits; and its strong resemblance to other species in the genus, especially *B. apurensis*.

Table 1. Morphological differences between *Bonamia apurensis* and *B. jiviorum*.

	B. apurensis	*B. jiviorum*
Coloration of pubescence in dried material	bronze	copper-ochraceous
Leaf blades	ovate to ovate-cordate, 6–14 × 3–10.5 cm	ovate-orbicular, 3.8–5.6 × 3.1–4.5 cm
Leaf blade apices	obtuse to acute, mucronulate	rounded to obtuse, mucronulate or minutely retuse
Pubescence of the adaxial surface of leaf blades	sparsely pubescent, concentrated toward base of primary and secondary veins	rough-tomentulose all over
Peduncles	5.1–15.2 cm	2.3–4 cm
Inflorescence bracts (in fructification)	ligulate to ligulate-spatulate, patent, 2.8–5 mm long	deltoid to narrowly triangular, adpressed, 1–3 mm long
Sepals	ovate, apex acute	orbicular, apex rounded
Pubescence of fruits	along margins and midvein of carpels, more conspicuously so at the apex	restricted to the apex
Seeds	seed surface slightly pustulate, smooth; seed wings < 0.1 mm	seed surface pustulate, striate; seed wings ca. 0.2 mm

Acknowledgments. Daniel Austin, Hermann Manitz, and Andrew McDonald made valuable comments that helped to improve the description of the species and the final version of the manuscript. I am grateful to Bruno Manara for the translation of the diagnosis into Latin and the excellent illustration; Otto Huber (VEN) for sharing his knowledge about the flora of the environs of Puerto Ayacucho; Leyda Rodríguez (curator of VEN) for allowing the study of the type material; and Gerardo Aymard (PORT) for kindly providing photographic material.

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A New Species of *Aspidistra* (Ruscaceae) from Guizhou, China

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ABSTRACT. The new species *Aspidistra pingtangensis* S. Z. He, W. F. Xu & Q. W. Sun (Ruscaceae) is described and illustrated from Pingtang County, Guizhou Province, China. The new species is characterized by an urceolate, milk-white perianth with five or six blunt keels externally, stamen filaments that are ca. 1.2 mm long with the stamens inserted in the top third of the perianth tube, and stigmas that are ca. 4 mm diam. This contrasts with the related species *A. fenghuangensis* K. Y. Lang and *A. urceolata* F. T. Wang & K. Y. Lang. The former is characterized by an urceolate, pale yellow perianth, stamen filaments that are ca. 0.5 mm with the stamens inserted at the middle of perianth tube, and stigmas that are ca. 6 mm diam.; the latter is characterized by an urceolate, pale violet-red perianth with many purple speckles, stamen filaments that are ca. 0.2 mm with the stamens inserted at the base of the perianth tube, and stigmas that are ca. 1.5 mm diam. The new species can be classified into *Aspidistra* Ker Gawl. sect. *Aspidistra* ser. *Fimbriatae* G. Z. Li.

Key words: *Aspidistra*, China, Guizhou, IUCN Red List, Ruscaceae.

During our 2007 investigation of medicinal plants in Pingtang County, Guizhou Province, China, a unique species of *Aspidistra* Ker Gawl. (Ruscaceae) was discovered in bloom in the Pingtang River Valley. The new species is remarkable for its urceolate, milk-white perianth with five or six prominent, blunt keels externally. This same taxon was also found in the adjacent Guiding County in October 2008. After searching the taxonomic literature (Lang, 1981; Lang et al., 1999; Li, 2004; Tillich, 2005, 2006, 2008; Tillich et al., 2007), we conclude that these collections represent an undescribed new species.

Aspidistra pingtangensis S. Z. He, W. F. Xu & Q. W. Sun, sp. nov. TYPE: China. Guizhou: Pingtang Co., under shrubbery in river valley, 2 Oct. 2007, *S. Z. He, W. F. Xu, Q. W. Sun & Y. Y. Wang 071002* (holotype, GZTM; isotype, MO). Figure 1.

Haec species quoad perianthium urceolatum *Aspidistrae fenghuangensi* K. Y. Lang et *A. urceolatae* F. T. Wang & K. Y. Lang similis, sed a hac foliis solitariis atque stigmate latiore, ab illa perianthii tubo lactineo atque stigmate angustiore, ab ambabus perianthii tubo carinato, staminibus ad tertiam partem superiorem tubi insertis atque filamentis longioribus distinguitur.

Perennial herb; rhizome creeping, subterete, 6–8 mm diam., rooting at nodes, covered with scales. Leaf sheaths 2 or 3, 3–11 cm, fibrous when withered; leaves solitary, 1.5–3 cm apart, petioles 26–28 cm, rigid and grooved, blades elliptic-lanceolate, 25–35 × 6–8 cm, green with yellowish white spots, apex acuminate, tapering to the petioles, with indistinctly small serratures at upper margin. Peduncles 1.2–3.5 cm; bracts 3 or 4, broadly ovate, 5–6 × 5–6 cm wide, purplish red; flowers solitary, erect. Perianth urceolate, 0.9–1 × 0.9–1 cm, milk-white, fleshy, tube 0.8–0.9 cm, 0.9–1.1 cm diam., with 5 or 6 prominent and blunt keels externally visible in the lower half, 5 or 6 purple-red markings internally, from top to bottom, perianth lobes 5 or 6, ca. 1.5 × 1 mm, purple-red; stamens 5 or 6, inserted at top 1/3 of the perianth tube; filaments ca. 1.2 mm, anthers suboblong, ca. 1.6 × 1 mm; stigma ca. 4 mm diam., convex centrally, the stigma peltate, orbicular, enlarged, split into a triangular concavity, with 3 radially slender keels, the stigmatic lobes 3, concave at apex but slightly convex in the middle. Fruit an obovate berry, 1.2–1.6 cm diam., the surface roughened, with verruciform projections.

Distribution and habitat. *Aspidistra pingtangensis* has a known distribution only in Pingtang and Guiding counties in Guizhou Province, China. The new species was observed to grow underneath shrubbery in the river valley, at elevations between 700 and 800 m.

IUCN Red List category. The geographic range of *Aspidistra pingtangensis* is estimated to be less than 1200 km², and its range is fragmented and limited to the Pingtang River Valley in limestone mountains, which accounts for only about 3% of the geographic range. We therefore preliminarily classify the new

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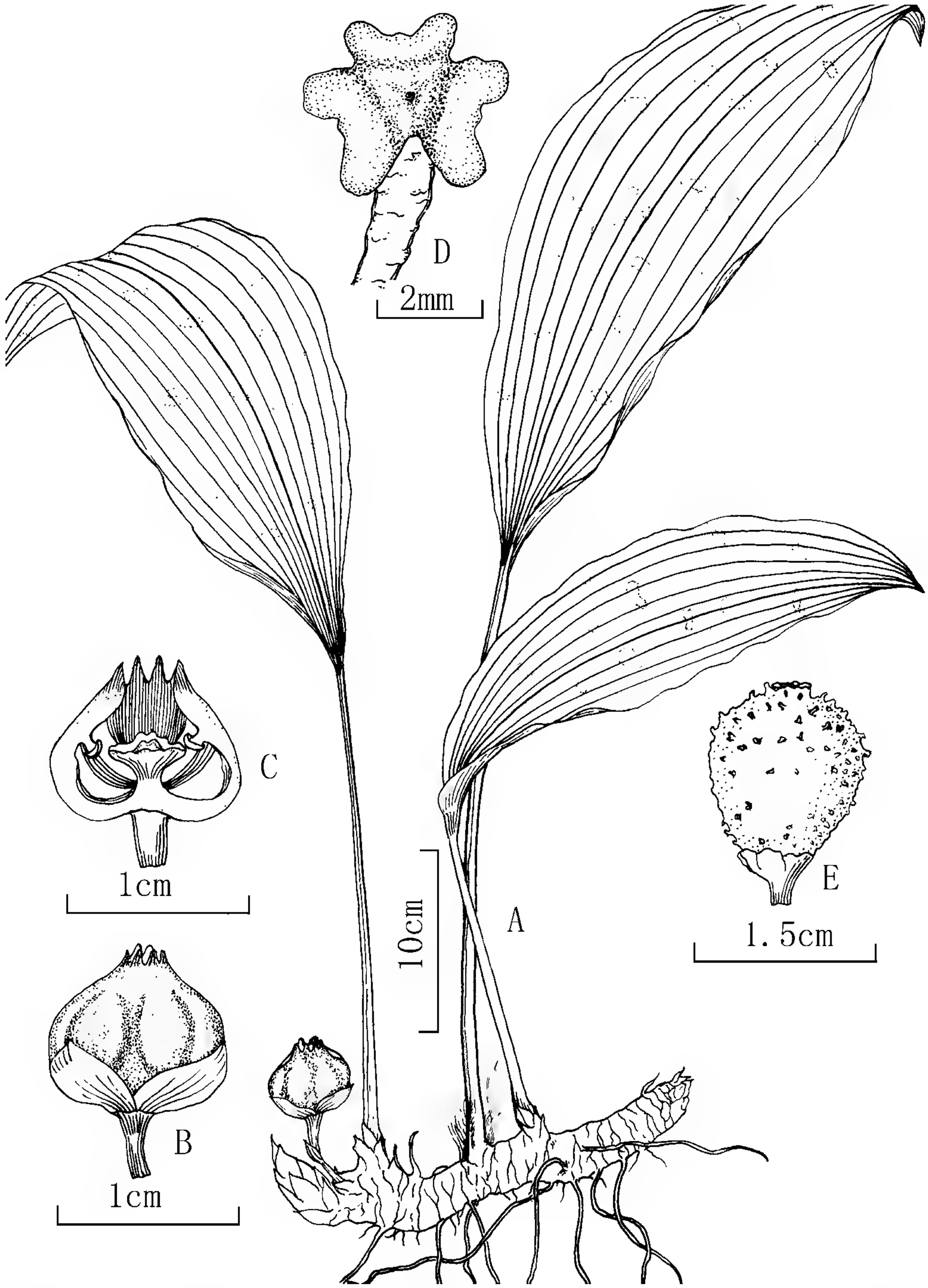

Figure 1. *Aspidistra pingtangensis* S. Z. He, W. F. Xu & Q. W. Sun. —A. Plant habit. —B. Flower. —C. Longitudinal section through flower. —D. Stigma. —E. Fruit. Drawn from the holotype *S. Z. He et al. 071002* (GZTM) by Xiang-li Wu.

species as Endangered (EN), according to IUCN Red List criteria (IUCN, 2001).

Phenology. The new species was collected in flower in October.

Relationships. *Aspidistra pingtangensis* is similar to *A. fenghuangensis* K. Y. Lang in its urceolate perianth and peltate stigma. The latter differs in its light yellow perianth that lacks blunt keels externally, the stamen filaments that are half as long (ca. 0.5

Table 1. Morphological comparison of *Aspidistra pingtangensis*, *A. fenghuangensis*, and *A. urceolata*.

Characters	*A. pingtangensis*	*A. fenghuangensis*	*A. urceolata*
Leaves	solitary	solitary	2 or 3 in a cluster
Perianth shape and color	urceolate, milk white	urceolate, yellow	urceolate, pale violet-red with purple speckles
Perianth keels	5 or 6 keels, prominent, blunt	none	none
Filament length (mm)	ca. 1.2	ca. 0.5	ca. 0.2
Stamen position within the internal perianth tube	inserted at the top 1/3 of the tube	inserted at the middle of the tube	inserted at the base of the tube
Stigma diameter (mm)	ca. 4	ca. 6	ca. 1.5

mm), and the stigma that is wider (to 6 mm diam.). The new species is also similar to *A. urceolata* F. T. Wang & K. Y. Lang in its urceolate perianth and pale violet-red perianth lobes with purple speckles; however, *A. urceolata* is distinguished by its more numerous leaves (two or three in a cluster), the stamen filaments ca. 0.2 mm and inserted at the base of the perianth tube, and the smaller stigmas (to 1.5 mm diam.). These differences are summarized in Table 1. All three species are endemic to China and have fragmented and restricted distributional ranges.

Aspidistra pingtangensis is classified into series *Fimbriatae* G. Z. Li of section *Aspidistra* because of the shape of the perianth and stigma, the characteristics of the perianth lobe, and the insertion point of the stamens on the internal perianth tube.

Paratypes. CHINA. **Guizhou:** Guiding Co., Pingfa, 18 Oct. 2008, *S. Z. He & W. F. Xu 081018* (Guiyang Coll. Trad. Chin. Med.).

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Valid Publication of *Asarum longirhizomatosum* (Aristolochiaceae)

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ABSTRACT. *Asarum longirhizomatosum*, originally described from Guanxi Province in China by C. F. Liang and C. S. Yang in 1975, was invalidly published in the original publication, because two collections were cited as type. The name is validated here by designating the collection *Chao-Liang Zhang 002* (IBK 00190377) as the holotype.

Key words: Aristolochiaceae, *Asarum*, China.

The genus *Asarum* L. s.l. (Aristolochiaceae), with about 90 species, is primarily distributed in southeastern Asia, with only a few species in North America and Europe (Kelly, 1998; Huang et al., 2003). Thirty-nine species have been recorded in China, and about 34 species are endemic (Huang et al., 2003). *Asarum longirhizomatosum* was originally described from Guanxi Province, southwestern China (Liang, 1975). This name has been widely used as it was included in the *Flora Reipublicae Popularis Sinicae* (Cheng & Yang, 1988: 192), and subsequently in the English edition, *Flora of China* (Huang et al., 2003: 256). However, the name was not validly published, because two collections were cited as "typus" in the original description (Liang, 1975: 21). The collections, *Chao-Liang Zhang 001* and *Chao-Liang Zhang 002*, were both separately and simultaneously designated as types, contrary to the requirements of Articles 37.1 and 37.2 (with Art. 8.1) of the *International Code of Botanical Nomenclature* (McNeill et al., 2006) for names published on or after 1 January 1958. In order to formalize usage of *A. longirhizomatosum*, the name is validated here by designating the collection *Zhang 002* as the holotype, which is preserved in good condition in IBK. Furthermore, upon contact to CMMI, the collection *Zhang 001* could not be confirmed by its curators (X.-F. Feng and Q.-J. Yuan at the Institute of Chinese Materia Medica, Academy of Chinese Medical Science, pers. comm.), and its existence is in doubt. According to Article 46.2, the authorship of the name *A. longirhizomatosum* remains as attributed to C. F. Liang & C. S. Yang. The spelling of the epithet is corrected in accordance with the Code's Recommendation 60G.

Asarum longirhizomatosum C. F. Liang & C. S. Yang, sp. nov. *Asarum longerhizomatosum* C. F. Liang & C. S. Yang, nom. inval., Acta Phytotax. Sin. 13(2): 21, pl. 1, fig. 2, pl. 2, fig. 4–10. 1975 [validating diagnosis]. TYPE: China. Guangxi: Daming Mtn., 1972, *Chao-Lian Zhang 002* (holotype, IBK 00190377; isotypes, IBK 00190376, 00190378).

In the English treatment for the *Flora of China*, Huang et al. (2003: 256) recognized that *Asarum longirhizomatosum* was not validly published. However, they did not validate the name, because they treated *Zhang 001* and *002* as a single collection, stating that "we prefer to regard the specimens as holotype and isotype and the name, therefore, as valid." In our opinion, *Zhang 001* and *002* clearly belong to two separate gatherings. This conclusion is based on the different collection numbers and the fact that, apart from the collection locality being noted as Daming Mountain, the three sheets of *Zhang 002* at IBK lack further label information (e.g., collection date, habitat, elevation) that could identify *Zhang 001* and *Zhang 002* as part of the same gathering.

Asarum longirhizomatosum is known from Guangxi Province, China, and extends south into Vietnam; it has been collected from thickets, open mountain slopes, and moist shady areas from an approximate known altitude of 200 m. To date, nine species of *Asarum* have been recorded from Guangxi Province; of these, *A. caudigerum* Hance and *A. geophilum* Hemsl. were also collected at Daming Mountain (Huang et al., 2003; pers. obs.). Morphologically, *A. longirhizomatosum* is similar to *A. sagittarioides* C. F. Liang by having connate sepals with a conspicuous orifice ring and constricted throat, and sepals that are not conspicuously pubescent adaxially. However, this species can be distinguished from *A. sagittarioides* in its slender stems with long rhizomes and fibrous roots (vs. robust with short rhizomes, and thick and fleshy roots), its oblong-ovate or narrowly elliptic-ovate leaf blades that are 5–8 cm wide (vs. narrowly or broadly ovate to triangular-ovate, and 11–14 cm wide), its solitary flowers (vs. usually paired), and its ligulate stamen connectives (vs. awl-shaped).

Paratypes, Asarum longirhizomatum. CHINA. **Guangxi:** Damingshan, 1972, *Chao-Liang Zhang 001* (CMMI not seen); Dongxing Co., 26 May 1972, *Nanyao Exped. 127* (IBK 00014455); Wuning Co., Daming Mtn., 26 Aug. 1958, *Y. C. Chen 327* (IBK); Mashan Co., Shangji, Daming Mtn., 26 Aug. 1958, *Y. C. Chen 453* (IBK); Shanglin Co., Xiyan, Daming Mtn., 27 Aug. 1958, *Y. C. Chen 623* (IBK). VIETNAM. **Dong Kinh:** Dahuangshan, 18 Dec. 1936, *W. T. Tsang 27296* (HITBC, IBSC).

Specimens examined, Asarum caudigerum. CHINA. **Guangxi:** Wuning Co., Daming Mtn., 26 Aug. 1958, *Y. C. Chen 328* (IBK).

Specimens examined, Asarum geophilum. CHINA. **Guangxi:** Shanglin Co., Xiyan, Daming Mtn., 28 Aug. 1958, *Y. C. Chen 632* (IBK).

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Jatropha mirandana (Euphorbiaceae), Especie Nueva de la Cuenca Oriental del Río Balsas de los Estados de Guerrero y Puebla, México

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Resumen. Se describe e ilustra *Jatropha mirandana* J. Jiménez Ram. & K. Vega (Euphorbiaceae), especie nueva y endémica a la Depresión del Río Balsas. El nuevo taxón es similar a *J. ciliata* Sessé ex Cerv., pero difiere en presentar pecíolo, lámina foliar, pedúnculo e inflorescencia de menor tamaño, además de tener diferencias en el tipo de corteza, la forma de la hoja, y en el color y forma de la corola pistilada.

Abstract. *Jatropha mirandana* J. Jiménez Ram. & K. Vega (Euphorbiaceae), a new and endemic species from the Balsas River Depression, is described and illustrated. This species is similar to *J. ciliata* Sessé ex Cerv., but differs from it by having the petiole, leaf blade, peduncle, and staminate cyme of smaller size; there are also differences in the type of bark, the shape of the leaf blade, and in the color and shape of the pistillate corolla.

Key words: Euphorbiaceae, Guerrero, IUCN Red List, *Jatropha*, Mexico, Puebla.

El género *Jatropha* L. (Euphorbiaceae) tiene alrededor de 186 especies (Govaerts et al., 2000), y una distribución natural en los trópicos del mundo, con excepción del este de Asia y de las islas del Océano Pacífico (Dehgan & Webster, 1979). En México existen 46 especies, de las que 35 son endémicas al país (Jiménez & Martínez, 2004). Si se incluyen *J. jaimejimenezii* V. W. Steinm. (2005) y la especie nueva propuesta en este trabajo, el porcentaje de endemismo mexicano alcanza el 78.7%, cifra mucho mayor al 52% de endemismo específico reportado por Rzedowski (1991) para toda la flora mexicana. La mayoría de las especies mexicanas pertenecen al subgénero *Curcas* (Adans.) Pax, y solamente siete de ellas se ubican en el subgénero *Jatropha*, de hecho, casi todas las especies del primer subgénero habitan en la república mexicana y algunas de ellas extienden su distribución al sur de Estados Unidos. *Jatropha costaricencis* G. L. Webster & Poveda y *J. stevensii* G. L. Webster son las únicas especies del subgénero *Curcas* endémicas de Centroamérica que no se encuentran en México.

En la porción poblana y guerrerense de la cuenca oriental del Río Balsas se ha registrado la presencia de *Jatropha andrieuxii* Müll. Arg., *J. ciliata* Sessé ex Cerv., *J. cordata* (Ortega) Müll. Arg., *J. elbae* J. Jiménez Ram., *J. oaxacana* J. Jiménez Ram. & R. Torres, *J. riojae* Miranda, *J. tlalcozotitlanensis* J. Jiménez Ram. y *J. websteri* J. Jiménez Ram. (Miranda, 1942; Jiménez, 1985, 1986, 1992; Jiménez & Martínez, 1994; y colectas recientes), a las que se agrega la nueva especie descrita en este trabajo. Todas las especies mencionadas son endémicas de la república mexicana y solamente *J. elbae*, *J. riojae*, *J. tlalcozotitlanensis* y el nuevo taxón tienen distribución restringida a la cuenca oriental del Río Balsas, y de estas solo *J. elbae* es un elemento frecuente y en ocasiones ecológicamente dominante en los bosques tropicales caducifolios en el estado de Guerrero y en una localidad del estado de Puebla. Las tres especies restantes en este grupo están en grave peligro de extinción porque tienen distribuciones en áreas geográficas muy pequeñas, no son abundantes y la vegetación en que habitan está siendo rápidamente alterada o destruida. Por ejemplo, *J. tlalcozotitlanensis* solamente se conoce de Tlalcozotitlán, Guerrero, y sus dos poblaciones conocidas están desapareciendo por el avance urbano y por la tala de la vegetación original. Caso semejante sucede con *J. riojae*, solamente conocida de los alrededores de Acatlán, Puebla, a través de las colectas de *F. Miranda 2111* (MEXU) en 1942 y de *J. Jiménez 1188* (FCME) en 1993, pero la intensa urbanización parece haberla eliminado, pues se le ha buscado intensamente en los alrededores de Acatlán durante los últimos años sin éxito alguno. Vale la pena señalar que la situación de las otras cinco

especies mencionadas que no tienen distribución tan restringida, tampoco es satisfactoria pues la perturbación de la vegetación es intensa, de manera que a mediano plazo también podrían tener problemas de supervivencia.

Jatropha mirandana J. Jiménez Ram. & K. Vega, sp. nov. TIPO: México. Puebla: Mpio. Albino Zertuche, Cerro Xilotzin, bosque tropical caducifolio, 17°58′42.9″N, 98°29′58.3″O, 1519 m, 26 jun. 2009 (fl.), *J. Jiménez & K. Vega 2009-128* (holotipo, FCME; isotipo, MO). Figura 1.

Haec species *Jatrophae ciliatae* Sessé ex Cerv. affinis, sed ab ea cortice protuberationibus praedito, petiolis et inflorescentiis staminatis brevioribus, lamina foliari plerumque breviore elobata basi leviter cordata, corolla staminata extus rubra usque albido-rosea intus rubra et corolla pistillata urceolata rubra usque rosea vel tubo albido lobis semper rubris differt.

Arbusto 1.5–2.5 m, con varios tallos de similar grosor y tamaño; corteza grís y lisa de la que surgen numerosas protuberancias verrucosas, alargadas y de poca elevación que en conjunto asemejan vagamente costillas. *Hojas* surgiendo de ramillas verdes y jóvenes, ocasionalmente sobre braquiblastos, estípulas diminutas y caducas; pecíolo (3–)3.4–5.2 cm; lámina 9.6–10.6 × 6.9–8.5 cm, anchamente ovada, base ligeramente cordada, ápice agudo a acuminado, margen entero y con algunas glándulas sésiles o ligeramente pediceladas, haz y envés pubescentes, glabrescentes en la madurez, venación palmada con 5 a 7 venas. *Inflorescencia* en individuos masculinos cimosa, 2.2–5.5 cm, pedúnculo 0.5–2.4 cm (en ocasiones ausente), brácteas 1–3.1 mm, lanceoladas, pedicelos 1.5–3.4 mm, individuos con inflorescencias estaminadas ocasionalmente presentan dicasios con una flor pistilada central y dos laterales masculinas; en los individuos femeninos las flores pistiladas surgen solitarias en las axilas de las hojas, pedicelo 8.3–9 mm. *Flores estaminadas* con sépalos 1–1.6 × 1–1.2 mm, en ocasiones connados en la base, oblongos, verdes o ligeramente rosados, pubérulos; corola gamopétala, tubular, roja o rosada o blanco-rosada en el exterior y roja en su interior, 6–6.5 mm, lóbulos 1.4–1.9 × 1.3–1.8 mm, reflejos; disco con 5 glándulas oblongas; estambres monadelfos y biseriados, serie externa 3.8–4 mm, connada 2–2.3 mm, serie interna 5.5–6 mm, connada 3.5–3.8 mm, anteras 0.9–1 mm. *Flores pistiladas* con sépalos 6–7.4 × 2–2.6 mm, oblongos, verdes, ápice redondo o agudo, rara vez se presentan algunas glándulas marginales; corola gamopétala, urceolada, roja, rosada o blanco-rosada con lóbulos rojos, 8.4–8.6 mm, lóbulos 3–3.5 × 2.4–2.6 mm, disco con 5 glándulas lenticulares; pistilo con 2 o 3 carpelos, 6–6.3 mm; estilos 2 o 3; estigmas 2 o 3 bifurcados. *Fruto* con (1)2(3) semillas, 2–2.1 × 2.4–2.6 × 1.7–1.8 cm; *semilla* elipsoide, 1.4–1.6 × 1.7–1.8 × 1–1.2 cm (eje dorso-ventral), carúncula residual.

Distribución y categoría de la Lista Roja de UICN. Solamente se conoce una pequeña población de *Jatropha mirandana* en el Cerro Xilotzin, en los límites entre los estados de Guerrero y Puebla, por lo que debe situarse la especie en peligro crítico (Critically Endangered o CR, de acuerdo con UICN, 2001), de hecho, los individuos colectados en 1981 en la porción guerrerense ya no existen porque se ha intensificado la destrucción de la vegetación original por el pastoreo de ganado bovino y ahora en el sitio de colecta domina un matorral espinoso de *Acacia farnesiana* (L.) Willd. Los ejemplares colectados por *E. Moreno* (*343* y *351*, FCME), señalan en la etiqueta que fueron hallados en Guerrero, pero, en realidad están situados dentro del territorio del estado de Puebla.

Habitat y fenología. La especie nueva se encuentra en el límite entre bosque tropical caducifolio y bosque tropical secundario, asociada a *Bursera schlechtendalli* Engl., *B. vejar-vazquezii* Miranda, *Actinocheita potentillifolia* (Turcz.) Bullock, *Brongniartia* Kunth y *Piscidia piscipula* (L.) Sarg., en suelo negro y somero derivado de roca caliza de la Formación Morelos a 1520–1650 m. *Jatropha mirandana* florece en junio y fructifica de junio a septiembre.

Etimología. El epíteto específico esta dedicado a Faustino Miranda (1905–1964), investigador del Instituto de Biología y profesor de la Facultad de Ciencias de la Universidad Nacional Autónoma de México. Figura fundamental en el desarrollo de la Botánica en México y pionero en los estudios de la flora de la cuenca oriental del Río Balsas.

Discusión. La especie nueva pertenece a la sección *Loureira* (Cav.) Müll. Arg. ex Pax del subgénero *Curcas* (sensu Dehgan & Webster, 1979), por presentar corola connada más de 1/3 de su longitud, inflorescencia masculina con muchas flores (que ocasionalmente tiene una flor femenina en la base), flores pistiladas usualmente solitarias, y generalmente dos carpelos (rara vez tres). Es posible insertar tentativamente a la nueva especie en la subsección *Canescentes* Pax ex Dehgan & G. L. Webster de la mencionada sección, por tener indumento en la hoja y el perianto, corteza íntegra y brácteas sin glándulas marginales, aunque la hoja y muy rara vez los sépalos de la flor pistilada de la

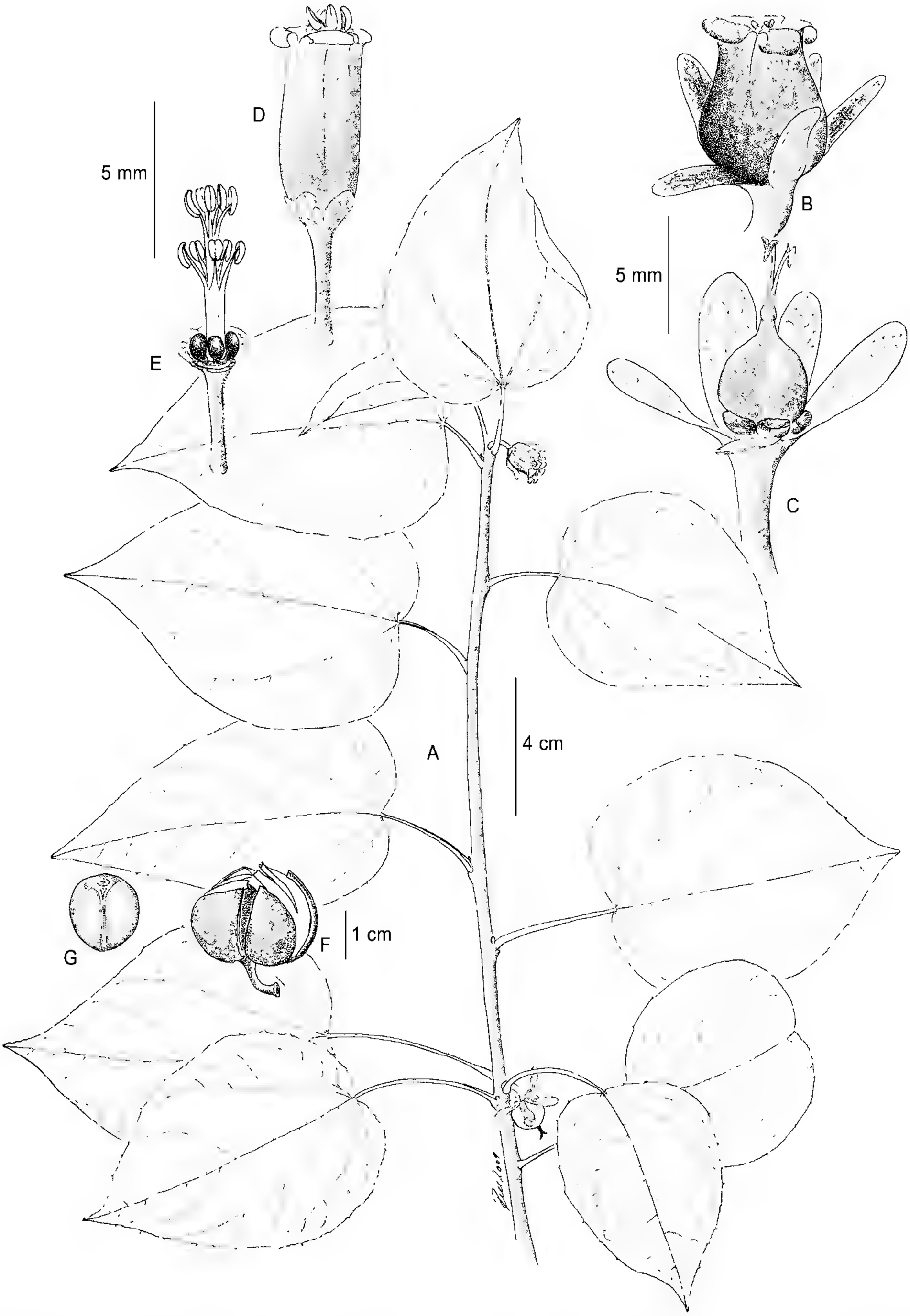

Figura 1. *Jatropha mirandana* J. Jiménez Ram. & K. Vega. —A. Rama con flor pistilada y fruto inmaduro. —B. Flor pistilada, vista exterior del cáliz y la corola. —C. Flor pistilada sin corola, vista del pistilo y el disco rodeados por los sépalos. —D. Flor estaminada, vista exterior de cáliz, corola y estambres. —E. Flor estaminada sin corola, vista del androceo y disco. —F. Fruto. —G. Semilla. A–C tomado del holotipo *Jiménez & Vega 2009-128* (FCME); D, E de *Jiménez & Vega 2009-126* (FCME); F, G de *Contreras 981* (FCME).

especie nueva tienen glándulas marginales como las especies de la subsección *Loureira* (Cav.) Müll. Arg. (sensu Dehgan & Webster, 1979), pero no puede ubicarse en este grupo por carecer de corteza exfoliante y de glándulas marginales en las brácteas, de manera que es necesario clarificar y redefinir los límites de ambas subsecciones para poder situar de modo indisputable a *Jatropha mirandana*.

La especie nueva tiene cierto parecido a *Jatropha ciliata*, porque ambas especies tienen tallo no exfoliante, venación palmada, corolas estaminadas tubulares, glándulas del disco similares en las flores de ambos sexos, pistilos con dos o tres carpelos, frutos y semillas con formas similares aunque con tamaños diferentes. Las diferencias entre ambas especies se presentan en una clave que se encuentra después del siguiente párrafo.

Es interesante señalar que existe una pequeña población de *Jatropha ciliata* a 1180 m de altura en la base del Cerro Xilotzin. A elevaciones más altas (1500–1650 m) fue colectada *J. mirandana*, lo que significa que ambas especies prefieren condiciones ambientales diferentes. Vale la pena aclarar que *J. ciliata* se ha colectado en altitudes mayores en otras localidades, pero en los recorridos efectuados en el Cerro Xilotzin por los autores y por Moreno (2002) en su estudio florístico del Cerro, nunca se ha ubicado a altitudes mayores.

1. Árboles o arbustos rizomatosos, hasta 4 m; corteza lisa; pecíolo 6–13.1 cm, lámina foliar con 3–5(–7) lóbulos, 7–17.5 × 6–14.5 cm, base conspicuamente cordada, margen con glándulas largamente pediceladas que en su mayoría se pierden en la madurez; inflorescencia estaminada hasta 16.5 cm, pedúnculo 6–7.9 cm; flor estaminada con corola blanca; flor pistilada con corola 7–14 mm, blanca, campanulada ..... *Jatropha ciliata*

1.′ Arbustos no rizomatosos con varios tallos de grosor similar, hasta 2.5 m; corteza lisa pero surcada de numerosas elevaciones alargadas y verrucosas; pecíolo (3–)3.4–5.2 cm, lámina foliar sin lóbulos, 9.6–10.6 × 6.9–8.5 cm, base ligeramente cordada, margen con glándulas sésiles o ligeramente pediceladas que permanecen en la madurez; inflorescencia estaminada hasta 5.5 cm, pedúnculo 0.5–2.4 cm o ausente; flor estaminada con corola roja o rosada o blanco-rosada en el exterior y roja en su interior; flor pistilada con corola 8.4–8.6 mm, roja, rosada o blanco-rosada con lóbulos rojos, urceolada ..... *Jatropha mirandana*

Paratipos. MÉXICO. **Guerrero:** Mpio. Xochihuehuetlán, Cerro Xilotzin, 3 km NW de Jilotepec, 22 jun. 1981, *J. L. Contreras J. 981, 987 & J. Jiménez* (FCME, MEXU). **Puebla:** Mpio. Albino Zertuche, Cerro Xilotzin, 3 km NO de Jilotepec, 29 jun. 1993, *E. Moreno G. 343* (FCME); Cerro Xilotzin, 3.5 km O de Jilotepec, 1570 m, 29 jun. 1993, *E. Moreno G. 351* (FCME); Cerro Xilotzin, 26 jun. 2009, *J. Jiménez & K. Vega 2009-124, 2009-125, 2009-126, 2009-127* (FCME); Cerro Xilotzin, 8 ago. 2010, *K. Vega 2540* (HUAP).

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Balsas (Sapindaceae), Género Nuevo de la Cuenca del Río Balsas en el Estado de Guerrero, México

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Resumen. Se describe el género *Balsas* J. Jiménez Ram. & K. Vega con una especie nueva, *B. guerrerensis* Cruz Durán & K. Vega (Paullinieae, Sapindaceae), de la Depresión del Río Balsas en el estado de Guerrero, México. *Balsas* se distingue de *Paullinia* L., por presentar cápsulas septífragas carnosas con alas proximales, dehiscencia que inicia proximalmente, semillas sin arilo y polen hemitrisincolporado.

Abstract. The genus *Balsas* J. Jiménez Ram. & K. Vega, with the new species *B. guerrerensis* Cruz Durán & K. Vega (Paullinieae, Sapindaceae), from the Rio Balsas Depression in the state of Guerrero, México, is described. Both taxonomic entities are distinguished from *Paullinia* L. and its species by having fleshy septifragal capsules with proximal wings, dehiscence that initiates proximally, seeds without an aril, and hemitrisyncolporate pollen.

Key words: *Balsas*, Balsas Depression, Guerrero, IUCN Red List, Mexico, Paullinieae, Sapindaceae.

En las exploraciones que se efectúan en el proyecto "Estudio florístico de la porción guerrerense de la Cuenca del Río Balsas, Parte I", se colectó una liana monoica con hojas pinnadas, zarcillos caulinares, flores zigomórficas, polen heteropolar y hemitrisincolporado (Fig. 1), cápsulas septífragas carnosas que poseen alas proximales y semillas sin arilo (Fig. 2). Además, la porción central de los frutos presenta una morfología peculiar, en su parte distal se encuentran los lóculos que alojan a las semillas y en su parte proximal existe un eje semejante a un carpóforo, al que están adheridas las alas. Weckerle y Rutishauser (2005) muestran algo similar en el fruto de *Cardiospermum halicacabum* L. donde se aprecia un estípite en la base de las valvas, pero éstas son papiráceas y las alas son dorsales y muy angostas.

La especie aquí descrita pertenece a la tribu Paullinieae Kunth (Sapindaceae), por ser trepadora, por poseer estípulas, flores zigomórficas y tener cuatro lóbulos nectaríferos, sensu Kunth (1821). Los géneros de esta tribu, según Acevedo-Rodríguez (1993, 1998) y Ferrucci y Acevedo-Rodríguez (2005), pueden ser separados por el tipo de fruto, así establecen que *Houssayanthus* Hunz., *Lophostigma* Radlk. y *Serjania* Mill. poseen esquizocarpos, mientras que *Urvillea* Kunth, *Cardiospermum* L. y *Paullinia* L. presentan cápsulas septífragas. *Urvillea* y *Cardiospermum* tienen pericarpio delgado y papiráceo y sus semillas tienen un arilo seco y muy pequeño, en cambio, *Paullinia* posee pericarpio carnoso o leñoso y sus semillas tienen arilo carnoso y conspicuo, según Weckerle y Rutishauser (2005), o sarcotesta, según Acevedo-Rodríguez (1993), que las envuelve parcial o totalmente. Ferrucci y Anzótegui (1993) señalan que el tipo de polen permite reconocer algunos géneros en Paullinieae, el polen hemitrisincolporado es característico de *Cardiospermum*, *Houssayanthus*, *Serjania* y *Urvillea*, el polen triporado de *Paullinia*, y el polen 2(3)-heterocolpado de *Lophostigma*; mientras que en *Thinouia* Triana & Planch. el polen es tricolporado.

Los trabajos fundamentales de la tribu Paullinieae, Radlkofer (1931) y Acevedo-Rodríguez (1993), los cuales presentan claves para reconocer los géneros, no permitieron ubicar la especie aquí presentada en ningún género conocido, por lo que se propone el

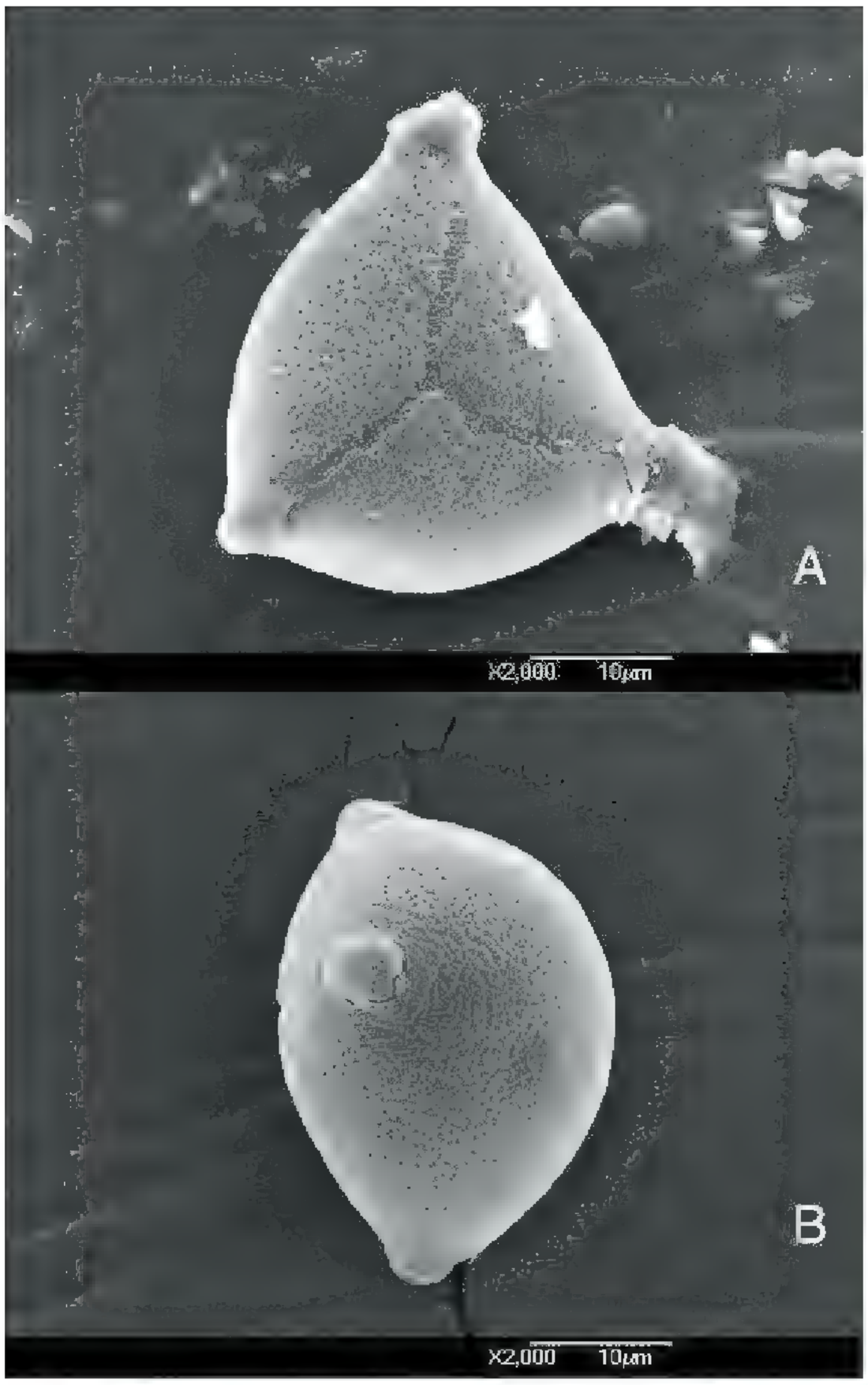

Figura 1. Polen de *Balsas guerrerensis* Cruz Durán & K. Vega (*Vega & Jiménez 1318*, holotipo, FCME). —A. Vista proximal. —B. Vista ecuatorial.

establecimiento de un género nuevo, al que se denomina *Balsas*, nombre que hace alusión a la región donde fue descubierto: la Cuenca del Río Balsas.

Balsas J. Jiménez Ram. & K. Vega, gen. nov. TIPO: *Balsas guerrerensis* Cruz Durán & K. Vega.

Hoc genus inter generos tribus Paullinieárum Kunth quoad habitum lignosum, fructum carnosum ac semina hilo albo carentia *Paulliniae* L. simillimum, sed ab ea fructu proximaliter alato dehiscentia in parte proximali incipiente, seminibus exarillatis atque polline hemitrisyncolporato distinguitur.

Lianas monoicas; tallos trígonos, con pubescencia uncinada, con un haz vascular central y uno adicional en cada ángulo; zarcillos 1- a 3-ramificados. Hojas pinnadas; estípulas 1.5–3 mm, lanceoladas, envés pubescente; folíolos 5, ovados a elípticos, venación craspedódroma mixta (sensu Hickey, 1979), margen dentado, cada diente terminado en una glándula, envés pardo y pubescente. Inflorescencias en tirsos axilares, cincinos de 3 a 9 flores, con 2 zarcillos en la base del raquis, pedúnculo corto, brácteas y bractéolas subuladas, flores zigomórficas. Flor masculina con pedicelo pubescente; sépalos 5, elípticos, pubescentes, desiguales, los dos externos más pequeños; pétalos 4, espatulados, cada uno asociado a un apéndice (2 caudados y 2 galeados), disco con 4 glándulas (2 apiculadas y 2 redondeadas), las apiculadas asociadas a los apéndices caudados; estambres 8, filamentos pubescentes y de tamaño desigual, anteras elípticas, polen hemitrisincolporado y heteropolar, pistilo rudimentario. Flor femenina con pedicelo pubescente; sépalos 5, elípticos, pubescentes, desiguales, los externos más pequeños; pétalos 4, espatulados, cada uno con un apéndice (2 galeados y 2 caudados); disco con 4 glándulas (2 apiculadas y 2 redondeadas), las apiculadas asociadas a los apéndices caudados; estaminodios 8,

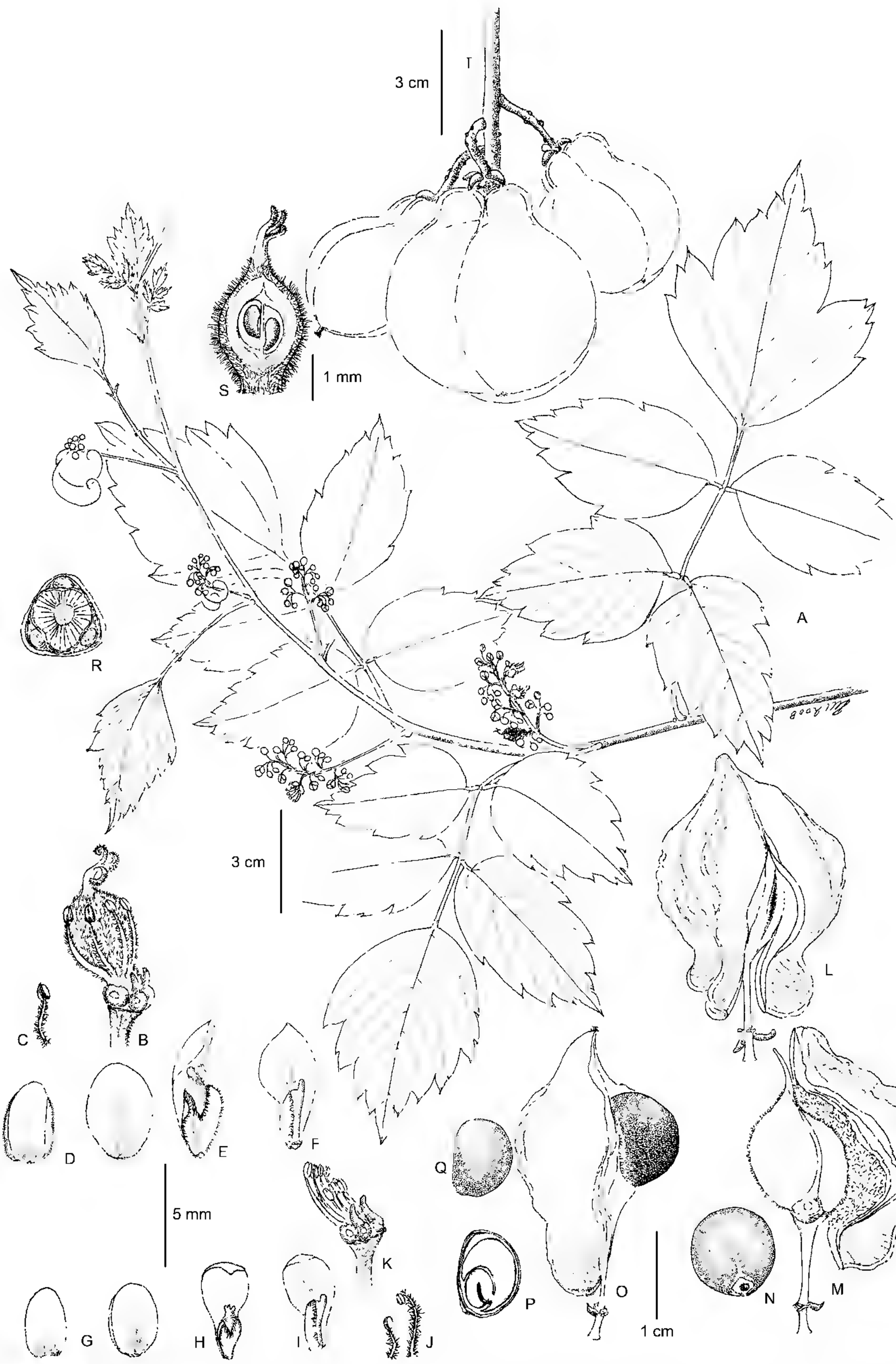

Figura 2. *Balsas guerrerensis* Cruz Durán & K. Vega. —A. Rama con flores. —B. Flor femenina. —C. Estambre flor femenina. —D. Sépalos, flor femenina. —E. Pétalo adaxial, flor femenina. —F. Pétalo lateral, flor femenina. —G. Sépalos, flor masculina. —H. Pétalo adaxial, flor masculina. —I. Pétalo lateral, flor masculina. —J. Estambres, flor masculina. —K. Flor masculina. —L. Fruto completo, deshidratado. —M. Fruto seccionado. —N. Semilla, vista ventral. —O. Fruto, vista lateral. —P. Embrión. —Q. Semilla, vista lateral. —R. Corte transversal de tallo. —S. Ovario. —T. Frutos frescos. A–K, S tomado de *Vega & Jiménez 1318* (FCME); L–Q, T de *Vega & Jiménez 1314* y *1319* (FCME); R de *Cruz 7325* (FCME). Las estructuras B–K están a una escala de 5 mm; las estructuras L–Q están a una escala de 1 cm; las estructuras R y S están a una escala de 1 mm.

filamentos pubescentes, anteras elípticas; ovario pubescente, estilo con tres ramas. Fruto una cápsula septífraga, esférica a piriforme, verde a pardo-verdosa con tricomas uncinados, pericarpio carnoso, coriáceo cuando se deshidrata, septos papiráceos y tomentosos; alas proximales; semillas una por lóculo, semiesféricas con una ligera compresión ventral, testa pardo oscura, sin arilo; embrión con cotiledones desiguales, el externo curvo y el interno biplicado.

A fin de distinguir el género *Balsas* del resto de los géneros de Paullinieae Kunth, se modificó la clave de Acevedo-Rodríguez (1993: 48):

4b. Frutos leñosos, carnosos o coriáceos; semillas sin hilo blanco; plantas leñosas.
6a. Fruto con alas proximales, la dehiscencia inicia en la parte proximal; semillas sin arilo; polen hemitrisincolporado ... *Balsas* J. Jiménez Ram. & K. Vega
6b. Fruto con alas distales o ausentes, la dehiscencia inicia en la parte distal; semillas con arilo; polen triporado ..... *Paullinia* L.

Balsas guerrerensis Cruz Durán & K. Vega, sp. nov. TIPO: México. Guerrero: Mpio. Copalillo, Papalutla, 6.66 km al SE, 17°59′32.3″N, 98°50′57.8″W, 1555 m, 28 jun. 2008 (fl.), *K. Vega y J. Jiménez 1318* (holotipo, FCME; isotipo, MO). Figura 2.

Liana de hasta 3 m; tallos trígonos, con pubescencia uncinada, con un haz vascular central y 3 periféricos situados en cada ángulo del tallo; zarcillos 1- a 3-ramificados. Hojas con estípulas 1.5–3 mm, lanceoladas, envés pubescente, pecíolo 2.6–6 cm, raquis (2–)2.6–3.2(–5.1) cm, folíolos 5, ovados a elípticos, con 4 a 5(7) dientes por lado, cada diente terminado en una glándula; ápice acuminado; venación craspedódroma mixta (sensu Hickey, 1979), haz verde, pubescente, envés pardo, pubescente, envés con venación evidente; los folíolos proximales (3.7–)4.5–6.1(–7.2) × (2–)2.6–3.3(–3.8) cm, peciólulo (0.2–)0.4–0.8 cm; los folíolos terminales (4.8–)7.6–8.4(–9) × (3–)4–4.8(–5.8) cm, peciólulo 0.4–1.4 cm; lámina con 3 nervios basales principales. Inflorescencias tirsos axilares, formados por cincinos con 3 a 9 flores, 3–7.5 cm; eje (sensu Acevedo-Rodríguez, 1993) 1.5–3 cm, pubescente; raquis pubescente; brácteas subuladas de hasta 1.5 mm; bractéolas subuladas, 0.5–1.5 mm. Flor masculina con 5 sépalos, cuculados, elípticos, margen ciliado, los 2 exteriores pubescentes, ca. 2 × 1.6 mm, los 3 internos pubérulos, 3.5–4 × 2.5–3 mm; pétalos 4, blancos, espatulados, glabros, ca. 5 × 3.5 mm, cada uno con un apéndice ciliado (2 caudados y 2 galeados); disco con 4 glándulas (2 apiculadas y 2 redondeadas); estambres 8, 4 de ca. 4.5 mm y 4 de 2.5–3 mm, con filamentos pubescentes; polen heteropolar, hemitrisincolporado, oblato, exina psilada perforada; pistilodio pubescente, 3–3.1 mm. Flor femenina con pedicelo pubescente de 2–2.5 mm, con 5 sépalos, cuculados, elípticos, los 2 externos pubescentes en el envés, 3.5–3.8 × ca. 2 mm, los 3 internos pubérulos, 4.3–4.5 × 3–3.5 mm; pétalos 4, blancos, espatulados, glabros, ca. 5 × 2.5 mm, cada uno con un apéndice ciliado (2 galeados y 2 caudados); disco con 4 glándulas (2 apiculadas y 2 redondeadas); estaminodios 8, filamentos pubescentes, 2.5–2.8 mm; pistilo ca. 5 mm, estigmas 3, estilo ca. 2.5 mm, ovario pubescente, 2.5–3 mm. Fruto una cápsula septifraga con pericarpio carnoso o coriáceo al desecarse, primero globoso y después piriforme al desecarse, verde a pardo-verdosa, 3.2–3.6 × 2–2.6 cm, con pubescencia uncinada, con alas basales pequeñas de hasta 0.8 cm; semillas una por lóculo, ca. 1.2 × 1.2 cm, semiesféricas con ligera compresión ventral, testa pardo obscuro, sin arilo; embrión con cotiledones desiguales, el externo curvo y el interno biplicado.

Distribución. *Balsas guerrerensis* solamente se distribuye en la porción oriental de la Depresión del Río Balsas en el estado de Guerrero, en altitudes de 1420–1555 m, y solamente se conocen tres localidades con menos de cinco individuos cada una, por ello es una especie en peligro crítico (Critically Endangered o CR), según los criterios de la UICN (2001).

Hábitat y fenología. Esta especie se encuentra en la transición de bosque de *Quercus castanea* Née y bosque tropical caducifolio asociada a *Serjania*, Graminae, Leguminosae, Compositae y *Bursera copallifera* (DC.) Bullock. Florece de julio a septiembre y fructifica de agosto a diciembre, cuando la temporada de lluvias se extiende más allá de lo normal (ver ejemplar *R. Cruz 7325*, FCME).

En la especie nueva, los frutos maduros, generalmente por el impacto de la caída al suelo, separan las valvas de los septos, liberando así a las semillas. En cambio, en las cápsulas no totalmente maduras, la dehiscencia sucede hasta que el pericarpio se deseca e inicia la dehiscencia en la parte proximal, donde se encuentran las alas, y continua progresivamente hacia la parte distal de los lóculos (lo mismo sucede a los pocos frutos que permanecen unidos a la planta madre) (Fig. 2L, M, O). La separación de las alas del estípite semeja el modo en que se separan los mericarpos del esquizocarpo de *Serjania*, pero como forman parte del cuerpo de la valva, no pueden desprenderse de manera independiente.

Paratipos. MÉXICO. **Guerrero:** Mpio. Copalillo, Papalutla, 6.66 km al SE, 1555 m, 1 dic. 2007 (fr.), *R. Cruz 7325*

(FCME), nov. 2007 (fr.), *K. Vega & J. Jiménez 1314* (FCME), 28 jun. 2008 (fl.), *1315*, *1316*, *1317* (FCME), 8 ago. 2008 (fr.), *1319* (FCME); Papalutla, 13 km al E, crucero Olinalá Xilitla Papalutla, 1400 m, 21 ago. 1992 (fr.), *A. Rincón 152* (FCME); Mpio. Eduardo Neri, la Yesera, 12.3 km al N de Zumpango del Río, 1420 m, 17 sep. 1994 (fr.), *M. Monroy 558* (FCME); la mina de yeso, 1540 m, 1 Oct. 1994 (fr.), *J. Calónico 1409* (FCME).

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Three New Distichous-bracted Species of *Calathea* (Marantaceae) from Panama

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Abstract. Three species of *Calathea* G. Mey. with distichous bracts, assigned to *Calathea* sect. *Calathea* (Marantaceae), are described as new from Panama: *C. carlae* H. Kenn., *C. chiriquensis* H. Kenn., and *C. fredgandersii* H. Kenn. All three are found in montane wet or cloud forest habitats at middle to higher elevations, 800–1400 m. *Calathea carlae* also occurs in Costa Rica, while the other two are endemic to Panama. *Calathea carlae* differs from related species by the leaf length:width ratios of 1.7–2.13:1, cream-colored bracts, claviculate bracteoles, yellow corollas, and yellow or pink-purple staminodes. *Calathea chiriquensis* is distinguished by the light green bracts, leaf length:width ratios of 1.3–1.56:1, absence of bracteoles, flowers borne singly rather than in pairs, and yellow flowers. *Calathea fredgandersii* is distinguished by the subround leaf, leaf length:width ratios of 1.15–1.55:1, a purple band along the leaf margin, a deep purple leaf sheath, verruculose petioles, white bracts, membranous bracteoles, white corollas, and white or pale pink to lilac staminodes.

Resumen. Tres especies de *Calathea* G. Mey. con brácteas dísticas, pertenecientes a *Calathea* sect. *Calathea* (Marantaceae), son descritas como nuevas de Panamá: *C. carlae* H. Kenn., *C. chiriquensis* H. Kenn. y *C. fredgandersii* H. Kenn. Las tres especies crecen en bosque húmedo montano o en bosque nublado a elevaciones medias a altas, 800–1400 m. Solo *C. carlae* crece además en Costa Rica, las dos otras especies son endémicas de Panamá. *Calathea carlae* se distingue de especies cercanas por las hojas con radio largo:ancho de 1.7–2.13:1, brácteas de color crema, bractéolas claviformes, corola amarilla y estaminodios amarillos o purpúreo-rosados. *Calathea chiriquensis* se distingue por las brácteas verde claras, las hojas con radio largo:ancho de 1.3–1.56:1, bractéolas ausentes, las flores solitarias, no en pares, y amarillas. *Calathea fredgandersii* se distingue por la hoja algo redondeada, las hojas con radio largo:ancho de 1.15–1.55:1, una banda purpúrea alrededor del margen de la hoja, vaina purpúrea oscura, pecíolos verruculosos, brácteas blancas, bractéolas membranáceas, corolas blancas y los estaminodios blancos o rosado pálidos a lila.

Key words: *Calathea* sect. *Calathea*, IUCN Red List, Marantaceae, Panama.

Since the publication of the Marantaceae treatment for *Flora of Panama* (Woodson & Schery, 1945), the number of species known for Panama has more than doubled. In the *Flora of Panama*, a total of 23 species were listed for the family, with 14 in the genus *Calathea*. In a paper entitled "Terrestrial Plants of Panama," Dressler (1972: 184) reported a total of 35 species for the family. In a paper describing new species from Panama, Kennedy (1976: 312) reported 49 species of Marantaceae known from Panama. Of these 49 species, 23 were in the genus *Calathea*, an increase from the original *Flora of Panama* treatment of ca. 160%. Six of these additional *Calathea* were new species from the then newly accessible El Llano–Cartí road (Panamá Province), an area which continues to be a rich source of undescribed taxa. Another rich area for Marantaceae is the region near Portobelo (Colón Province), especially the forests along the Río Guanche, where an additional five new *Calathea* species were discovered. The building of the Fortuna Dam in Chiriquí Province led to greater access for botanists to the surrounding montane wet and cloud forest habitats. Collections from this area and the adjacent provinces of Bocas del Toro and Veraguas proved critical for an understanding of the three distichous-bracted species described herein. Currently some 59 species (ca. 156% increase from the 1945 *Flora of Panama* treatment) of Marantaceae, including 16 endemic species, are known for Panama; this total includes the three new *Calathea* species described here. Of these 59 species, 43 are in *Calathea*, triple the number reported in the original *Flora of Panama* treatment, of which 13 are endemic, including two of those being described here.

The three new species described herein belong to *Calathea* sect. *Calathea*, which includes the type for the genus. In Schumann's (1902: 70) key to this group (as *Calathea* subgen. *Eucalathea*), the leads

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Table 1. Comparison of leaf and inflorescence characters among three described and three new distichous-bracted Panamanian species of *Calathea*.

Character	*C. crotalifera*	*C. spiralis*	*C. brenesii*	*C. carlae*	*C. chiriquensis*	*C. fredgandersii*
Recurved bract margin	no	no	no	yes	yes	yes
Petiole type	smooth	smooth	smooth	smooth	smooth	verruculose
Leaf length:width ratio	1.38–1.95:1	2.2–2.56:1	(1.53–)1.7–2.6:1	(1.7–)1.78–2.13:1	(1.3–)1.36–1.56:1	1.15–1.44(–1.55):1
Leaf length (cm)	30–90	36–60	(14–)18–60	43–90	(24–)29–55.5	23–41
Bract color	bright yellow to yellow-orange	white, faint greenish white, faint yellow-green	cream-white, faint greenish white, or purple	cream-white, greenish white	light green to light yellow-green	white to cream with pink tinge
Bract dimensions (cm)	2.9–3.5 × 4.2–5.4	1.4–1.8 × 2.4–3	1.6–2.7 × 1.8–3.6	2–3 × 2.8–4.4	2.8–3.7(–4.2) × (2.9–)3.5–4.4	(2–)2.2–2.7(–3.1) × (2–)2.6–3.4
Bracteoles	2(1), membranous	2, membranous	2, membranous	1, indurate claviculate	absent	2, membranous

are "Bracteae distichae" and "Inflorescentia a laterere complanata. . .." Petersen (1890: 89) treated it as a section (as "Sect. VII. Distichae."), stressing the presence of distichous bracts, which characterizes the majority of species in this group. The new species described herein clearly exhibit these characters. *Calathea* sect. *Calathea* is characterized by the presence of several basal leaves and a single cauline leaf subtending one to several distichous, occasionally spirodistichous-bracted, complanate inflorescences; open flowers usually with callose staminode totally callose; and yellow to orange capsules with deep blue (rarely gray) seeds bearing white (rarely colored) arils (Kennedy, 1988). Furthermore, most species of this section exhibit a distinctive leaf venation pattern of seven minor veins between the raised, major veins. Of the Panamanian species, *Calathea spiralis* H. Kenn. is an unusual case. The bracts are distichous in Costa Rica and usually Panama, but in a few Panamanian populations, including the type locality, the bracts are spirally arranged. The majority of the species in other sections of *Calathea* have spirally arranged bracts. Those few that do have distichous bracts (e.g., *C. villosa* Lindl.) differ substantially in leaf and floral features and would never be confused with species in *Calathea* sect. *Calathea*. One of the most commonly collected and widespread species in this section is *C. crotalifera* S. Watson. A number of species with distichous bracts have often been confused with *C. crotalifera* because, once pressed, they are much more similar in aspect than in live material, the bract color and recurved margin character are less evident. The distichous-bracted species occurring in the higher elevations, usually above 800 m, have bracts that are white, cream, greenish white, or pale green, but not the bright yellow to yellow-orange color of *C. crotalifera*. The three new species are compared to three related Panamanian species in Table 1.

1. **Calathea carlae** H. Kenn., sp. nov. TYPE: Panama. Chiriquí: Fortuna Dam rd. (Oleoducto rd.), past Fortuna Dam, on rd. bank, 1133 m, 08°46′08.5″N, 82°12′33″W, 28 July 2005, *H. Kennedy & C. Black 6116* (holotype, PMA; isotypes, MO, UCR). Figure 1.

Haec species a congeneris bracteis distichis praeditis foliorum lamina ovata caulinorum proportione longitudinis cum latitudine 1.7 2.13, bracteis cremeis albidoviridibusve marginibus apicialibus recurvatis, bracteolis claviculatis, sepalis pilosis, corolla lutea atque staminodiis luteis roseopurpureisve distinguitur.

Caulescent herb, 1.7–3.5 m high, bearing 3 to 6 basal leaves and 1 cauline leaf above a stem

internode 1.2–2.2 m; stem green to light green, minutely tomentose to subhispid where exposed, subglabrous to glabrous where covered by leaf sheath; cataphylls coriaceous, narrowly ovate, apiculate, innermost cataphyll 54–73 cm. Leaf blade firm, coriaceous, ovate, apex obtuse with somewhat eccentric acumen, base rounded, shortly abruptly attenuate, 43–90 × 21–46 cm (length:width ratios [1.7–]1.78–2.13:1), 22 to 25 lateral veins per 3 cm (measured at midpoint of either side of lamina); leaf blade adaxially dull green but semi-shiny over major veins, glabrous except tomentose with minute hairs at apex, hairs 0.2–0.3 mm, midrib light yellow-green, glabrous; leaf surface abaxially light yellowish green, glabrous except minutely tomentose alongside midrib near apex, midrib yellow-green, minutely tomentose; pulvinus elliptic in cross section, deep olive-green or with tinge of purple giving a brownish cast, light yellow-green just at junction to petiole, glabrous except minutely tomentose in ca. 2 mm band along front, hairs ca. 0.2 mm, 6–14 cm in cauline leaves, 8.7–17.5 cm in basal leaves; petiole light green, subglabrous with few minute hairs just below pulvinus and above sheath, (4–)7–41 cm in cauline leaf, 75–185 cm in basal leaves; leaf sheath not auriculate, back green to light green, wings lighter, minutely tomentose at apex and along margin, hairs more dense toward base and on both wings and back in cauline leaves, 16.5–25 cm in cauline leaf, 73–118 cm in basal leaves. Inflorescences 1 to 5 per shoot, first one terminal, subsequent ones axial, imbricate, strongly complanate, rectangular, (10.5–)12.5–22 × 4.2–5.3 cm; peduncle light green, darker just below inflorescence, minutely hispid, hairs ca. 0.3 mm, 14–36.5 cm; bracts (14 to)20 to 31, distichous, stiff, chartaceous, broadly obovate, basalmost bract depressed obovate-elliptic, conduplicate, apex retuse, sinus somewhat truncate, apical margin adjacent to sinus recurved, 2–3 × 2.8–4.4 cm; each bract subtending 6 or more flower pairs; outer surface of bracts cream-white, cream at base, tinged olive-green at junction with rachis, densely minute appressed tomentose at base, hairs more sparse toward apex, sparsely tomentose along margin; inner surface glabrous; rachis visible, deep olive-green, densely appressed tomentose, hairs tan, obscuring surface; bicarinate prophyll chartaceous, membranous at apical margins, thickened, stiff, especially at base and adjacent to carina, broadly obovate-elliptic, apex emarginate, cream-colored to tannish cream, sides and carinae appressed tomentose, center back glabrous, 1.6–2.1 × 1.1–1.6 cm, 0.6–1.1 cm wide from carina to carina; secondary bract membranous, broadly elliptic to subrectangular, apex emarginate, translucent pale cream-yellow, (1.5–)1.8–2.1 × (1.1–)1.4–1.7 cm; bracteoles 1 per flower pair, indurate claviculate, medial, thickened apical portion light yellow, glabrous, 1.9–2.2 cm. Sepals membranous, narrowly obovate-elliptic, acute to 90°, pale cream-yellow, sparsely minutely appressed tomentose medially in apical half, glabrous basally, 26–27 × 5–6 mm; corolla tube golden, appressed pilose, 28–35 mm; corolla lobes subequal, elliptic, acute, pale yellow, sparsely minutely pilose, hairs colorless, ca. 0.1 mm, barely visible at ×14, 12–16 × 3.5–5 mm; outer staminode broadly elliptic, clawed at base, apex rounded, cupped, yellow or pink-purple, 11–13 × 9–12 mm; callose staminode obovate, apex unequally bilobed, lobes petaloid, the rest callose, yellow-orange to golden or pink-purple, 10–13 mm; cucullate staminode deep coral-colored or golden with trigger tinged pink, 6–9 × ca. 4 mm; stamen yellow or pinkish with lateral petaloid appendage; anther yellow, 2.5–3 mm; style and stigma golden, cream-colored, or pale pink; ovary white, smooth except for cluster of minute protuberances just below sepal junction with faint greenish tinge, glabrous, 2.5–3 × 1.5–2 mm. Capsule obovoid, cream-yellow, glabrous.

Distribution and phenology. *Calathea carlae* occurs at mid-elevations, from 760 to 1400 m, in premontane wet to cloud forest habitat, in moderate shade. In Panama, *C. carlae* appears to be concentrated in the Fortuna Dam region, found in both Chiriquí and Bocas del Toro provinces. This taxon is represented by a single collection from Coclé Province, but so far has not been noted for Veraguas Province, though it would be expected to occur there. Interestingly, *C. carlae* turned up in a batch of specimens received at Missouri Botanical Garden from Costa Rica in August 2010. Many of the cloud forest habitats, both in Panama and Costa Rica, are not readily accessible during the height of the rainy season, which may account for the paucity of collections. Flowering is noted as primarily during the rainy season, April to August.

IUCN Red List category. Conservation for *Calathea carlae* should be considered as Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001), because it is only known from a rather small number of collections. However, its recent collection in Limón Province of Costa Rica suggests the possibility of greater distribution within the intervening areas.

Etymology. This species is named in honor of Carla Black of Volcán, Chiriquí, for her great enthusiasm for heliconias and related plants. Also,

Figure 1. *Calathea carlae* H. Kenn. —A. Habit. —B. Flower, face view. —C. Inflorescence. —D. Flowers on adaxial leaf surface. Photos of the holotype, *Kennedy & Black 6116* (PMA). Photos by the author.

she is acknowledged for providing field transport in Panama, accommodations both for me and my live Marantaceae, and especially for taking me to study these three new species in the wild.

Discussion. *Calathea carlae* belongs to *Calathea* sect. *Calathea*. The new species is distinguished from other species of *Calathea* with distichous bracts by the ovate leaves with length:width ratios of (1.7–) 1.78–2.13:1 in cauline leaves, cream to whitish green bracts with recurved apical margins, claviculate bracteoles, pilose sepals, yellow corollas, and yellow or pink-purple staminodes. It differs from *C. chiriquensis* and *C. fredgandersii* by the higher leaf length:width ratios (more than 1.7:1 vs. less than 1.56:1) and the claviculate bracteoles, and additionally from *C. chiriquensis* in the cream versus green bracts and less strongly recurved bract margins. Vegetatively, *C. carlae* differs from *C. fredgandersii* in its smooth versus verruculose petioles. It differs from *C. brenesii* Standl., a Costa Rican endemic, by the sparsely tomentose, apically recurved bract margins versus densely tomentose and straight bract

margins, the claviculate versus membranous bracteoles, and the longer sepals (26–27 mm vs. 15–21 mm). Both taxa have a plain green adaxial leaf surface and cream bracts with the lowermost bract often distinctly separated from those above.

The bract color is reported as "pale yellow" (*W. G. D'Arcy et al. 15892*) or "greenish white" (*H. W. Churchill 5822A*). The corolla color is given as "yellow-white" (*W. G. D'Arcy et al. 15892*) or "flower white" (*H. W. Churchill 5822A*). In populations I have observed, including the type collection, the corolla was pale yellow and staminodes either yellow or pink-purple, polymorphic within a population. Leaves often dry grayish green versus brown, and the bracts usually retain their lighter cream color. Frequently the rachis is readily visible in live as well as dried material.

Paratypes. COSTA RICA. **Limón:** Cantón de Limón, Z. P. Río Banano, Cuenca del Banano, Valle La Estrella, Filla Matama, ca. 11 km SO del Pueblo de Aguas Zarcas, 09°48′46.8″N, 83°10′05.95″W, 24 Oct. 2007, *A. Rodriguez et al. 11471* (MO). PANAMA. **Bocas del Toro:** Fortuna Dam area, Oleoducto rd., near Cont. Divide, 08°47′N, 82°13′W, 31 July 1984, *H. W. Churchill 5822A* (MO, PMA); Fortune Dam rd. (Oleoducto rd.), past Fortuna Dam, 33.5 34 km from Los Planes, near rd. markers Km 65 66, 08°47′00″N, 82°10′52″W, 28 July 2005, *H. Kennedy & C. Black 6122* (UCR), *H. Kennedy & C. Black 6123* (PMA); Chiriquicito Calderas Trail betw. Quebrada Higueron & Gutierrez, 08°47′N, 82°13′W, 18 Apr. 1968, *J. H. Kirkbride Jr. & J. A. Duke 762* (MO). **Chiriquí:** Fortuna Dam area, just N of reservoir, in ravine, 31 July 1984, *W. G. D'Arcy, H. W. Churchill & C. Todzia 15892* (PMA); Km 110, 16 July 1982, *J. J. Him 522* (MO). **Coclé:** Atlantic slopes, past sawmill above El Cope, 25 Aug. 1983, *W. J. Kress & B. Hammel 83-1596* (DUKE).

2. Calathea chiriquensis H. Kenn., sp. nov. TYPE: Panama. Chiriquí: vic. of Gualaca ca. 8.5 mi. from Planes de Hornito, La Fortuna on rd. to dam site, near stream, 4400 ft., 10 July 1980, *T. Antonio 5075* (holotype, PMA; isotypes, MEXU, MO, UBC). Figure 2.

Haec species a congeneris bracteis distichis praeditis lamina foliari late ovata proportione longitudinis cum latitudine 1.3 1.56, bracteis viridibus luteoviridibusve marginibus apicalibus valde recurvatis, bracteolis nullis atque floribus plerumque non geminatis luteis luteoviridibusve distinguitur.

Caulescent herb, 1.2–2 m high, bearing 2 to 6 basal leaves and 1 cauline leaf, above a stem internode 71 cm or more; stems green; cataphylls coriaceous, narrowly ovate, apiculate, innermost cataphyll ca. 21–37 cm. Leaf blade chartaceous, broadly ovate, apex obtuse to rounded with acumen, base rounded, shortly abruptly attenuate, occasionally slightly subcordate, (24–)29–55.5 × (15–)21.5–38 cm, length:width ratios (1.3–)1.36–1.56:1, 18 to 25 lateral veins per 3 cm (measured at midpoint of sides of blade); leaf blade adaxially shiny deep green, glabrous except acumen and apical margin of wider side densely appressed tomentose, hairs ca. 0.5 mm, midrib nearly concolorous, minutely tomentose in center and onto margins of midrib, hairs essentially colorless, 0.2–0.5 mm; leaf blade abaxially light green to gray-green, very minutely strigose sparsely scattered throughout but with hairs concentrated along and over the veins, barely felt, hairs ca. 0.1 mm with bulbous base, midrib tannish yellow-green, appressed tomentose, hairs faintly tan, ca. 0.2 mm, to glabrous at apex; pulvinus olive-green, occasionally tinged with purple, light green at junction with petiole, glabrous or sparsely appressed tomentose along upper side, hairs 0.2–0.4 mm, hairs more dense at junction with petiole, nearly confluent, (3.5–)4.3–8(–10) cm; petiole green, surface minutely reticulated and slightly rough to touch just below pulvinus, smooth below, glabrous, (17.5–)23.5–43(–57) cm in cauline leaves, up to 105 cm in basal leaves; leaf sheath not auriculate, green, or tinged purple apically, appressed tomentose at very base and onto adjacent stem, hairs sparse or subglabrous apically, margin minutely tomentose, 16–31.5 cm in cauline leaf, 23–48 cm in basal leaves. Inflorescences 1 to 4 per shoot, first one terminal, subsequent ones axial, imbricate, strongly complanate, rectangular, 11–18(–20) × (3–)4–6.5 cm; peduncle green, densely appressed tomentose in uppermost 0.5 cm, hairs sparser basally to subglabrous by 4 cm or more, 16.5–36(–45) cm; bracts 13 to 26, softly pliable, distichous, overlapping at base in live material, rachis usually not visible, transverse broadly elliptic, conduplicate, apex retuse, apical 1/3–1/2 of margin recurved, 2.8–3.7(–4.2) × (2.9–)3.5–4.4 cm, the basalmost bract often separated (to 4.3 cm) from upper ones and larger; each bract subtending 5 to 7 unpaired flowers; outer surface of bracts light green to yellow-green, sparse, very minutely hispid in marginal 1/3–1/2, hairs along outermost 1 mm of basal margin to 0.2 mm, hairs sparse or glabrous apically; inner surface shiny, glabrous; bicarinate prophyll thickened, callose at base and along carina, sides membranous, ovate-elliptic, apex obtuse or with slight acumen, translucent pale yellow to chartreuse, sides minutely tomentose, sparse in basal half except at very base hairs dense and longer, center back glabrous, 2.1–2.5 × 1–1.2 cm, 0.7–0.8 cm wide from carina to carina; secondary bract membranous, elliptic, apex rounded, translucent pale yellow to chartreuse, sparsely minutely strigose in apical 1/3,

Figure 2. *Calathea chiriquensis* H. Kenn. —A. Habit. —B. Inflorescence. —C. Flowers on leaf. —D. Flower, face view. —E. Seeds and capsules on leaf. Photos of *Kennedy & Black 6115* (UCR). Photos by the author.

glabrous basally, 1.9–2.2 × 1.1–1.4 cm; bracteoles apparently absent. Flowers usually unpaired; sepals membranous, narrowly obovate, acute to 90°, translucent white basally, upper 1/3–1/2 pale yellow, apical 1/3 minutely appressed pilose, subglabrous basally except pilose at very base, 21–26 × 5–5.5 mm; corolla tube light yellow, appressed pilose, hairs 0.4–0.8 mm, 22–25 mm; corolla lobes subequal,

elliptic, obtuse to 90°, incurved, appearing acute, yellow with apex yellow-orange to cream-colored, minutely pilose, hairs ca. 0.1–0.2 mm, 12–16 × 3–4.5 mm; outer staminode obovate, rounded, bright yellow, 10–14 × 8–12 mm; callose staminode callose except petaloid at apical margin, elliptic, apex bilobed, apical margin recurved, yellow-orange, 12–15 mm; cucullate staminode yellow, thickened central portion coral-colored, 7–8.5 × ca. 4 mm; filament coral-colored with lateral, yellow-orange, petaloid appendage, ca. 1.5 mm wide; anther white, ca. 3 mm; style and stigma orange; ovary smooth, pale yellow, glabrous except pilose right at junction to sepals, 2–2.5 × ca. 1.5 mm. Capsule obovoid, pale yellow, pilose at junction to sepals, glabrous below, ca. 11–12 mm high, crowned by a persistent, pale yellow calyx; seeds trigonous, rugose on outer surface, blue, 6.5–7.5 × 4–4.5 × 3–3.5 mm, bearing a white aril, ca. 3 mm long.

Distribution and phenology. *Calathea chiriquensis* is endemic to Panama with a more restricted distribution than the other two species described here. It is currently known only from Chiriquí and Bocas del Toro provinces in the general region of the Fortuna Dam. *Calathea chiriquensis* occurs at mid-elevations, 800–1400 m, in premontane wet to cloud forest habitat, in the forest understory. Flowering is noted from February to September (November).

IUCN Red List category. Conservation for *Calathea chiriquensis* should be considered as Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001), because it is only known from a rather small number of collections.

Etymology. As this species is primarily found in Chiriquí Province, the specific epithet *chiriquensis* seemed fitting.

Discussion. *Calathea chiriquensis* belongs to *Calathea* sect. *Calathea*. The new species is distinguished from other species of *Calathea* with distichous bracts by the broadly ovate leaf blades, length:width ratios of (1.3–)1.36–1.56:1, the green to yellow-green bracts with strongly recurved apical margins, the absence of bracteoles, the flowers usually unpaired, and the yellow to greenish yellow flowers. Leaf blades, petiole, and sheaths of the new taxon usually dry fairly uniform brown and, unlike *C. fredgandersii*, do not show a blackish leaf sheath or a purple band on the leaf blade abaxial surface. The leaf sheath and petiole are essentially smooth to the touch, whereas they are distinctly roughened verruculose in *C. fredgandersii*. In most pressed specimens, the recurved margins end up folded back, and this recurved character is quite evident. *Calathea chiriquensis* most closely resembles *Calathea* sp. A. (Kennedy, 2003: 654) from Costa Rica. Both taxa share a similar bract color with a strongly reflexed bract margin and yellow flowers, but differ as to bracteoles and flower pairs. Besides the absence of bracteoles, an even more unusual floral feature of this species was that the flowers were borne singly rather than in pairs. This striking anomaly was discovered when dissecting pickled material sent from Chiriquí, unfortunately after the loan material had been returned. A few unmounted specimens, all from Chiriquí, were examined and all showed the unpaired flower character. This is quite unusual and possibly just a freak occurrence as the population size examined is so small. So far, this has only been recorded in the greatly reduced basal inflorescences, bearing cleistogamous flowers, in *C. micans* (L. Mathieu) Körn. and *C. fucata* H. Kenn. (Kennedy, 1988: 131–135). Unpaired flowers are characteristic of the Neotropical genus *Monotagma* K. Schum.

The bract color is reported on labels as green or greenish yellow and flower color as pale yellow, yellow-orange, yellowish green, whitish green, cream, or white. However, *W. J. Kress & S. Knapp 82-1354* note "Bracts bright green, flowers yellow and pink." It may be that this species also exhibits the color polymorphism of yellow or pink-purple flowers as found in *Calathea carlae* and *Calathea* sp. A, mentioned above.

Paratypes. PANAMA. **Bocas del Toro–Chiriquí:** along the divide, 23 June 1986, *W. J. Kress, H. Luther, L. Besse & J. Halton 86-1981* (MO, SEL). **Bocas del Toro:** de la cabaña del Sr. Lino subiendo el filo al SE de la cabaña, 23 Nov. 1990, *J. Aranda B., B. Cuevas, J. Araúz, E. Ponce & F. Arosemena 1618* (PMA); Fortuna Dam area, Oleoducto rd., near Cont. Divide, 08°48′N, 82°12′W, 5 Feb. 1984, *H. W. Churchill, G. de Nevers & H. Stockwell 4485* (MO); along rd. betw. Fortuna Dam & Chiriquí Grande, along gravel rd. which departs main hwy. near Cont. Divide (4.5 mi. N of bridge over Fortuna Lake), just S of border with Bocas del Toro Prov., 08°44′N, 82°17′W, 22 June 1987, *T. B. Croat 66634* (MO); Pipeline Rd. 2 km from Fortuna Hwy., trail below Cont. Divide, 25 June 1986, *W. J. Kress, H. Luther, L. Besse & J. Halton 86-2024* (MO, SEL). **Chiriquí:** Rd. to Fortuna Dam site N of Gualaca, 22.7 mi. beyond Río Estí bridge, 22 Nov. 1979, *T. Antonio 2794* (MO); vic. of Gualaca ca. 8.5 mi. from Planes de Hornito, La Fortuna on rd. to dam site, near stream, 10 July 1980, *T. Antonio 4148* (MO); Valle de la Sierpe, SE a lo largo de Quebrada Bonita, *M. D. Correa A. 5119* (MO, PMA); along rd. from Gualaca to Fortuna Dam site, 5.9 mi. NW of Los Planes de Hornito, 08°43′N, 82°17′W, 9 Apr. 1980, *T. B. Croat 49877* (MO); along rd. betw. Gualaca & Fortuna Dam site, 8.3 mi. NW of Los Planes de Hornito, 08°44′N, 82°16′W, 9 Apr. 1980, *T. B. Croat 49952* (MO); along hwy. betw. Gualaca & Chiriquí Grande, 1 km S of Cont. Divide & Bocas del Toro boundary, 08°45′N, 82°18′W, 26 June 1987, *T. B. Croat 66855* (MO); Gualaca Chiriquí Grande, 7.2 mi. beyond Planes de

Hornito, 19 Sep. 1987, *T. B. Croat 67819* (MO); Fortuna Dam Area, Fortuna Chiriquí Grande, 1.8 mi. NW of center of dam, 08°45′N, 82°18′W, 27 June 1994, *T. B. Croat & G. Zhu 76498A* (MO); Fortuna Dam region, Camp Hornito, camp to Landau to Pitti to camp, 08°44′N, 82°10′W, 27 Sep. 1976, *R. L. Dressler 5502* (PMA, UCR); La Fortuna Hydroelectric Project, near camp, 19 Mar. 1978, *B. Hammel 1996* (MO); La Fortuna area, ca. 7 mi. N of Los Planes de Hornito, along small draw, 26 Aug. 1985, *B. Hammel & W. J. Kress 13476* (DUKE); 1 km N of Fortuna Lake, 08°45′N, 82°13′W, 10 Mar. 1983, *R. J. Hampshire & C. Whitefoord 405* (BM, MEXU, MO); Fortuna Dam rd. (Oleoducto rd.), 12.5–13 km from Los Planes, just S of Smithsonian Field Station, 08°43′04″N, 82°14′06″W, 31 July 2005, *H. Kennedy & C. Black 6115* (UCR); IRHE Fortuna Hydroelectric Project, N of Carr. del Oleoducto, Quebrada de Arena, 08°46′N, 82°12′W, 12 Mar. 1982, *S. Knapp, W. J. Kress & B. Hammel 4080* (MO); La Fortuna Dam project, slopes above Quebrada de Arena, 12 Mar. 1982, *W. J. Kress & S. Knapp 82-1354* (DUKE, PMA); slope NW of confluence of Río Hornito & Río Chiriquí, ca. 08°44′N, 82°13′W, 11 Nov. 1980, *W. D. Stevens 18344* (MO, UBC); Distr. Boquete, Fortuna Dam site, 6 Feb. 1984, *H. van der Werff & C. van Hardeveld 6582* (MO, UBC).

3. Calathea fredgandersii H. Kenn., sp. nov. TYPE: Panama. Veraguas: vic. of Escuela Agricultura Alto Piedra, near Santa Fé, along trail to top of Cerro Tute, near stream, 3500 ft., 29 July 1980, *T. Antonio 4954* (holotype, PMA 30230; isotypes, MO 5304353, UBC 192832). Figure 3.

Haec species a congeneris bracteis distichis praeditis petiolo verruculoso, lamina foliari late ovata vel subrotunda proportione longitudinis cum latitudine 1.15 1.55, inflorescentia saepissime solitaria, bracteis albis cremeisve, bracteolis membranaceis atque floribus albis lavandulisve distinguitur.

Caulescent herb, 0.75–2 m high, bearing (0)2 to 5 basal leaves and 1 cauline leaf above a stem internode 54–86 cm or more; cataphylls stiff, chartaceous, narrowly ovate, apiculate, dark purple, minutely tomentose to subhispid, veins prominent, surface finely ridged when dry, innermost cataphyll ca. 26 cm long; stem green, verruculose and strigose apically. Leaf blade stiff, chartaceous, subround, broadly elliptic to broadly ovate, length:width ratios of 1.15–1.44(–1.55):1, apex obtuse to rounded with pronounced slightly eccentric acumen, base rounded to truncate, occasionally shortly abruptly attenuate, 23–41 × 18–31.5 cm in cauline leaves, 36–58 × 24–35 cm in basal leaves; vein spacing (measured at midpoint of lamina) 16 to 24 veins per 3 cm; leaf blade adaxially deep green, glabrous except acumen and adjacent apical margins densely appressed tomentose, midrib deep green, appressed tomentose, hairs to 1 mm, golden brown; leaf surface abaxially pale gray-green with purple-tinged band to 3 cm wide along margin of narrower side (portion of blade rolled to the outside), glabrous, midrib olive-green, appressed tomentose, hairs golden brown, glabrous in apicalmost 2 cm; pulvinus elliptic in cross section, olive-green, glabrous, occasionally with very sparse hairs ca. 0.1 mm, articulate, thinner than petiole, 3–7.5(–9) cm; petiole brownish olive-green, appearing honeycombed, aveolate, markedly verruculose, scabrid, 3–31(–40) cm in cauline leaf, 34.5–73 cm in basal leaves; leaf sheath not auriculate, central back portion green, wings tinged purple, very margin appressed tomentose, hairs shorter, strigose toward back, center back portion reticulate, verruculose apically, with small warts bearing hairs toward base, hairs at base to 1 mm, wings ridged, more pronounced when dried, hairs on minute protuberances between veins, 13.5–21.5 cm in cauline leaf, 45–59 cm in basal leaves. Inflorescences 1, rarely 2, per shoot, terminal, imbricate, strongly complanate, rectangular, usually borne above the level of the leaves, 8–16 × (2.9–)3.5–4.5 cm; peduncle green, tinged brownish just below inflorescence, slightly verruculose, apical 0.3–0.5 cm densely appressed tomentose, hairs golden brown ca. 0.5 mm, the basal portion covered with minute papillae each bearing a hair 0.5–0.7 mm, hairs sparser toward the base, 25–60(–70) cm long; bracts (13 to)16 to 21, distichous, stiff, chartaceous, basalmost bract broadly transverse elliptic, upper bracts broadly transverse obovate, conduplicate, retuse, sinus truncate, rather than rounded, apical margins recurved, (2–)2.2–2.7(–3.1) × (2–)2.6–3.4 cm; each bract subtending 5 or more flower pairs; rachis green to dark olive-green, sparsely tomentose; outer surface of bracts white to cream, sometimes with faint pinkish tinge in young bracts, very base of bract usually olive-green, especially in basalmost bract, subglabrous, sparse very minute hairs < 0.1 mm (×27 magnification) barely felt, slightly more dense along midline or hairs restricted to edge of apical margin (*Hammel 3563*); inner surface glabrous; bicarinate prophyll membranous, elliptic to subrectangular, apex broadly obtuse to rounded, occasionally with short acumen, appressed pilose along margins near apex and on carina in apical 1/4–1/3, the rest glabrous, 1.8–2 × 0.9–1.2 cm, 0.5–0.7 cm wide from carina to carina; secondary bract membranous, ovate-elliptic, apex rounded, glabrous or minutely pilose along apical margin, glabrous basally, 1.7–1.9 × 1–1.2 cm; bracteoles 2 per flower pair, medial, membranous, 1-channeled, 1-carinate, narrowly elliptic, glabrous, 1.5–1.8 × 0.3–0.45 cm. Sepals thin, herbaceous, narrowly elliptic, acute to 90°, margins incurved, white, glabrous, occasionally 3 or 4 hairs (at ×27 magnification) at apex, 15–21 × 4–5 mm; corolla white, tube

Figure 3. *Calathea fredgandersii* H. Kenn. —A. Leaf and inflorescence. —B. Flower, face view. —C. Base of pulvinus and upper portion of verruculose petiole. Photo A, property of SCZ herbarium, photographed by Carmen Galdames (*Galdames et al. 5507*, SCZ), used with permission of Mireya Correa, curator. Photo B by Bruce Dunstan, near Fortuna, Chiriquí Province. Photo C by Carla Black, *Kennedy & Black 6126* (UCR).

densely minutely appressed pilose, 12–16 mm long, shorter than sepals; corolla lobes white, subequal, elliptic, narrowly obtuse, inrolled appearing acute in live material, appressed pilose, hairs ca. 0.2 mm, 9.5–13 × 3.5–5 mm; staminodes white, pale pink, or purplish pink, callose staminode somewhat deeper colored than others; outer staminode obovate, cupped apically, apex rounded, 7–8.5 × 5–7.5 mm; callose staminode almost totally callose, only apical 1–2 mm of acumen petaloid, obovate-rectangular, apex acuminate, occasionally very shortly bilobed, 8–10.5 mm; cucullate staminode 5–7 × 3.5–4.5 mm; stamen white or pale pink with lateral petaloid appendage; anther white or pink, ca. 2 mm; style and stigma pinkish white to deep pink; ovary smooth, white, glabrous, ca. 2.5 mm. Capsule obovoid, cream-colored, glabrous, crowned by a persistent calyx; seeds usually 3 per capsule, trigonous, rugose on outer surface, blue, 5.5–7 × 4–4.5 × 3.5–4 mm, bearing a fibrous white aril to 4 mm.

Distribution and phenology. *Calathea fredgandersii* occurs at mid-elevations, 800–1350 m, in premontane wet to cloud forest habitat, in relatively dense shade often near streams. *Calathea fredgandersii*, like *C. chiriquensis* and *C. carlae*, occurs in the general region of Fortuna Dam in Chiriquí Province, but appears to be most abundant in Veraguas Province, where neither of the other two species have been recorded. *Calathea fredgandersii* and the sympatric *C. carlae* are each known from a single collection in Coclé Province. Flowering is noted as mainly from (December to)February to July and fruiting from April through September(to October).

IUCN Red List category. Conservation for *Calathea fredgandersii* should be considered as Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001), because it is known from few populations in a relatively restricted area, though it is relatively abundant in Veraguas Province. The difficulty of collecting in these montane wet habitats,

while reducing the threat, also limits our knowledge of these species.

Etymology. This species is named in honor of Fred R. Ganders, former director of the UBC Herbarium, in gratitude for his funding of my Marantaceae fieldwork and herbarium studies and for botanical and oenological consultation.

Discussion. *Calathea fredgandersii* belongs to *Calathea* sect. *Calathea*. The new species is distinguished from other species of *Calathea* with distichous bracts by its broadly ovate, subrotund (length:width ratios of 1.15–1.44[–1.55]:1) leaf blades, the verruculose petioles, the single inflorescence of white to cream bracts, the membranous bracteoles, and white or lavender flowers. In dried specimens the dark brownish to blackish purple leaf sheath and the broad purple band along the narrower side (half rolled to outside in young, unopened leaves) of the blade are very distinctive of this species. The wings of the sheath are very dark throughout, but the back portion is lighter near the apex, although the basal third to half of the leaf sheath is dark all around. The sympatric *C. chiriquensis*, when dry, has medium brown leaf sheaths with the wings (sides) the same color as the back (occasionally lighter), the underside of the leaf is uniform in color, lacking a darker marginal band, and has virtually smooth petioles. *Calathea chiriquensis* is readily distinguished in the field by the smooth versus verruculose petioles, green versus white bracts, and the usually two or more inflorescences. The citation of *C. brenesii* as occurring in Panama (D'Arcy, 1987; Correa et al., 2004) was due to my tentative identification of dried specimens of *C. fredgandersii*, as such. *Calathea fredgandersii* and *C. brenesii* share membranous bracteoles, a similar bract color, the distinctive separation of the lowermost bract from the upper ones, and the rachis (usually) evident in dried material. However, the verruculose petiole and very dark leaf sheath of *C. fredgandersii* readily distinguish the two. Most similar in general morphology is *Calathea* sp. B (Kennedy, 2003: 654) from Costa Rica. Both share the subround leaves, distinctively verruculose petioles, usually single inflorescence, and recurved bract margins. *Calathea fredgandersii* is readily distinguished from *Calathea* sp. B by the white versus chartreuse bracts and membranous versus claviculate bracteoles.

The bract color is usually reported on labels as white, but ivory, yellow-white, and greenish cream have been mentioned. Flower color is polymorphic. The staminodes are either white, like the corolla, or pale pink to pinkish purple.

Paratypes. PANAMA. **Bocas del Toro–Chiriquí:** along the divide, 23 June 1986, *W. J. Kress, H. Luther, L. Besse & J. Halton 86-1985* (MO, SEL); above Fortuna Dam, ca. 08°45′N, 82°15′W, 3 Dec. 1985, *G. McPherson 7712* (MO). **Chiriquí:** Fortuna Dam area, North Quebrada de Arena, along river, 08°46′N, 82°12′W, 7 Feb. 1984, *H. W. Churchill, G. de Nevers & H. Stockwell 4711* (MO); rd. from Fortuna Lake to Chiriquí Grande, trail W of Cont. Divide, 08°47′N, 82°13′W, 22 Mar. 1985, *R. J. Hampshire & C. Whitefoord 866* (BM); ca. 1 km from main, Fortuna Dam rd. (Oleoducto rd.), Sendero Los Tucanes, ca. 0.5 km in along trail, start of trail at 8°47′07″N, 82°12′51″W, 31 July 2005, *H. Kennedy & C. Black 6126* (MEXU, PMA, UCR); windswept ridge 8 km N of Los Planes de Hornito, IRHE Fortuna Hydroelectric Proj., 08°45′N, 82°12′W, 9 May 1982, *S. Knapp 5005* (MO); windswept ridge 10 km N of Los Planes de Hornito, IRHE Fortuna Hydroelectric Proj., 18 June 1982, *S. Knapp & Vodicka 5608* (MO); La Fortuna Dam site, 8 mi. from Planes de Hornito, 13 Mar. 1982, *W. J. Kress, B. Hammel & S. Knapp 82-1352* (DUKE, PMA), *82-1357* (DUKE, PMA); Reserva La Fortuna, Divide Trail, 11 May 1991, *B. M. O'Connor 91-0511-013* (MICH, MO). **Coclé:** Pacific drainage, on ridge W of Sawmill above El Copé, 21 June 1978, *B. Hammel 3563* (MO). **Veraguas:** Cerro Tute, ca. 5 km W of Santa Fé, along path, 14 May 1981, *L. Andersson & K. J. Sytsma 1281* (MO, NY); Distr. de Santa Fé, Serrania de Tute, de Mirador hasta la encima, 08°33′N, 81°07′W, 5 July 1996, *J. Aranda, C. Galdames, B. Araúz & S. González 2656* (SCZ); Cerro Tute, NW of Santa Fé, 10 11 Oct. 1976, *R. L. Dressler 5528* (MO, PMA); "Cerro Tute," ridge up from former Escuela Agrícola, Santa Fé, 08°35′N, 81°05′W, 20 Feb. 1983, *C. Hamilton & R. L. Dressler 3047* (MO), *3079* (MO); "Cerro Tute," ridge up from former Escuela Agrícola, Santa Fé, 08°35′N, 81°05′W, 15 July 1983, *C. Hamilton & K. Krager 3984* (MO), *3996* (MO); mtns. W of Alto de Piedras, W of Santa Fé, 8 Sep. 1978, *B. Hammel 4630* (MO); ridge of Cordillera de Tute, trail to Cerro Tute, above Escuela Agrícola Alto de Piedra, just W of Santa Fé, 08°32′N, 81°07′W, 5 June 1982, *S. Knapp & R. L. Dressler 5420* (MO, PMA); Cerro Arizona, above Santa Fé, 27 Apr. 1980, *W. J. Kress 80-1185* (MO); Cerro Tute, along ridge trail toward summit, 08°30′N, 81°07′W, 21 Mar. 1987, *G. McPherson 10738* (MO).

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Elatostema oppositum (Urticaceae), a New Species from Yunnan, China

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ABSTRACT. A new species of *Elatostema* J. R. Forst. & G. Forst. (Urticaceae), *E. oppositum* Q. Lin & Y. M. Shui, belonging to section *Weddelia* (H. Schroet.) W. T. Wang ser. *Stipulosa* W. T. Wang, is described and illustrated from Yunnan Province, China. The new species was found on limestone rocks at altitudes of 1700–1940 m and differs from the other species in series *Stipulosa* by its paired staminate inflorescences that are opposite one another at the stem nodes (staminate inflorescences are solitary in the other species of *Elatostema* ser. *Stipulosa*) and by its pistillate inflorescences in pairs at the leaf base or opposite one another at the stem nodes (pistillate inflorescences are solitary in the other species of this series). The new species is related to *E. nasutum* Hook. f., but can be distinguished by its stems that are longitudinally striate, the paired staminate inflorescences opposite one another at the stem nodes, the pistillate inflorescences in pairs or opposite one another at the stem nodes, and the staminate flowers that are 5-merous.

Key words: China, *Elatostema*, IUCN Red List, Urticaceae, Yunnan.

The genus *Elatostema* J. R. Forst. & G. Forst. (Urticaceae) consists of 300 to 350 species and is distributed throughout tropical and subtropical Africa, Asia, and Oceania. Eighty-two species are known to occur in Yunnan Province, China (Lin et al., 2003; Wei & Wang, 2009). The most recent infrageneric classification for Chinese taxa of *Elatostema* was proposed by Wang and Chen (1979) and Wang (1980, 1990), and included five sections (*Elatostema* sect. *Pellionioides* W. T. Wang, *Elatostema* sect. *Weddelia* (H. Schroet.) W. T. Wang, *Elatostema* sect. *Laevispermae* (Hatus.) T. Yamaz., *Elatostema* sect. *Elatostema*, and *Elatostema* sect. *Androsyce* Wedd.). *Elatostema* sect. *Weddelia* comprises 10 series, within which the new species described here is assigned to *Elatostema* ser. *Stipulosa* W. T. Wang.

The type locality for the new species is in Malipo County between latitude 23°7′N and longitude 104°41′E, and comprises a range with many limestone hills. Our fieldwork in southeastern Yunnan Province, in southwestern China, took place in April 1998, July 1999, and March and May 2002. This previously unknown species was collected on limestone rocks, and is herein described and illustrated as new.

Elatostema oppositum Q. Lin & Y. M. Shui, sp. nov. TYPE: China. Yunnan: Malipo Co., Zhongzai to Xiao-Ping-An village, 1700 m, 23 Mar. 2002, *Y. M. Shui, W. H. Chen, J. S. Sheng, S. D. Zhang & C. L. Fan 20287* (holotype, PE; isotype, KUN). Figure 1.

Species nova quae a ceteris speciebus *Elatostematis* seriei *Stipulosarum* W. T. Wang inflorescentiis masculinis oppositis atque femineis binis vel oppositis, a *E. nasuto* Hook. f. caulibus longitudinaliter striatis, stipulis brevioribus subulatis atque floribus staminatis pentameris differt.

Perennial herbs, monoecious or dioecious, 15–50 cm tall, glabrous or glabrescent; stems ascending, simple or branched, longitudinally striate. Leaves alternate; nanophylls absent; stipules 2, subulate, 5–7 mm, glabrous, without cystoliths, deciduous; petioles 0–2 mm; leaf blades obliquely narrowly lanceolate, obliquely elliptic-obovate, or obliquely elliptic, 2.5–17.5 × 1.2–6.3 cm, papyraceous or chartaceous, brown-black after drying, the 2 major basal lateral veins asymmetric, one arising above the other basal vein, cystoliths conspicuous, dense, random, rod-shaped, small, 0.1–0.15 mm; leaf blade bases asymmetric, broader side broadly cuneate or nearly rounded, narrower side attenuate, margins dentate, apex long acuminate. Staminate inflores-

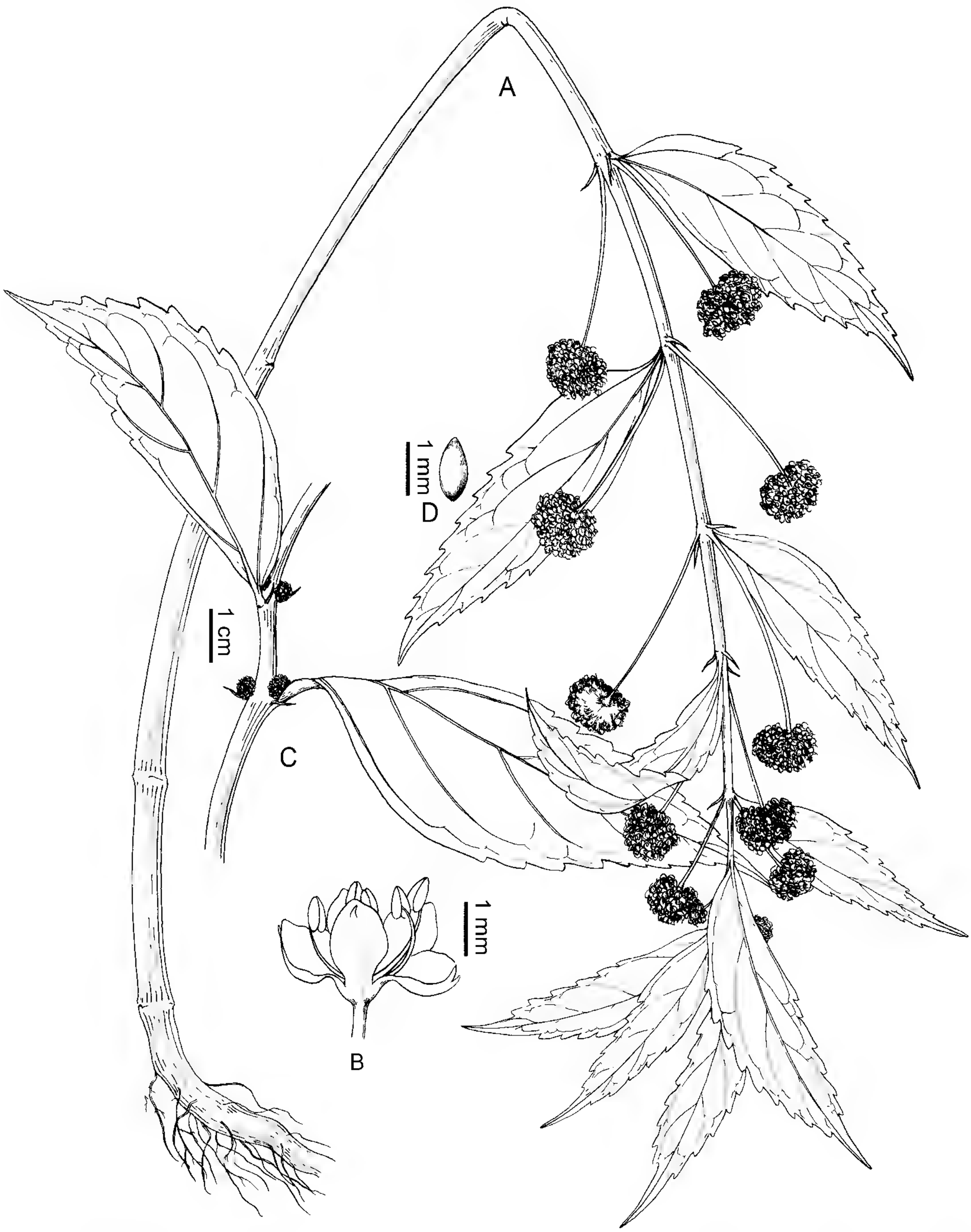

Figure 1. *Elatostema oppositum* Q. Lin & Y. M. Shui. —A. Staminate habit. —B. Staminate flower. —C. Portion of fruiting stem. —D. Achene. A, B drawn by Ai-Li Li from the holotype, *Y. M. Shui, W. H. Chen, J. S. Sheng, S. D. Zhang & C. L. Fan 20287* (PE); C, D from *Y. M. Shui, R. Z. Fang & W. H. Chen 21228* (PE).

cences opposite each other at the same stem node with the node either bearing a leaf or without a leaf, one staminate inflorescence opposes the leaf base, with the second one at the bract base, or both found at bract bases when the stem node is leafless, simple, 6–16 mm diam.; bracts linear or narrowly lanceolate, 5–10 mm, deciduous; peduncle 0.5–3.5 cm; receptacle 2.5–5 mm diam.; involucral bracts 10 to 12, in a single whorl, ovate, ca. 0.5 mm, persistent; bracteoles linear-spatulate, ca. 1 mm. Staminate flowers 5-

Table 1. Comparison of morphological characteristics of *Elatostema oppositum* and *E. nasutum*.

Characters	*E. oppositum*	*E. nasutum*
Stems	longitudinally striate	without striae
Stipules	subulate, 5–7 mm, glabrous, without cystoliths	narrowly ovate or linear, 9–18 mm, glabrous, without cystoliths
Leaf blade	obliquely narrowly lanceolate, obliquely elliptic-obovate, or obliquely elliptic, 2.5–17.5 × 1.2–6.3 cm, brown-black after drying	obliquely elliptic or elliptic-ovate, 3–9(−18) × 2–3.5(−6.5) cm, brown-black after drying
Staminate inflorescences	opposite	solitary
Pistillate inflorescences	opposite	solitary
Staminate flowers	5-merous	4-merous

merous, the perianth lobes elliptic, white, ca. 0.3 mm; stamens 5; pistil rudimentary. Pistillate inflorescences paired at a stem node, or opposed to one another at stem nodes bearing a single leaf, only one pistillate inflorescence at the leaf base, with the second one at the bract base, 4–5 mm diam.; bracts subulate or linear, 2–4 mm, deciduous; sessile; receptacle ca. 2 mm diam.; involucral bracts narrowly ovate, ca. 0.1 mm, persistent; bracteoles linear-lanceolate, very small. Achenes ellipsoidal, ca. 10-ribbed.

Distribution and habitat. *Elatostema oppositum* is only known from its type locality in southeastern Yunnan, southwestern China. This species was collected on limestone rocks at altitudes of 1700–1940 m.

IUCN Red List category. The new species seems to be very rare and restricted in its distribution, and approximately 30 populations were found during our fieldwork. *Elatostema oppositum* should be considered Critically Endangered (CR) according to IUCN Red List criteria (IUCN, 2001).

Phenology. Flowering was observed in *Elatostema oppositum* from March to May, with fruiting from May to July.

Discussion. *Elatostema oppositum* is assigned to *Elatostema* sect. *Weddelia* ser. *Stipulosa*, because it has the diagnostic characters for that series, which include herbaceous habit, 3-veined leaf blades with the two basal lateral veins asymmetric to one another, and dentate leaf margins. The staminate inflorescences are simple, involucrate, and long-pedunculate; the staminate receptacles are small. The pistillate inflorescences are multiflorous and sessile; the pistillate receptacles are also small. The fertile bracts are conspicuous, and the achenes are small and ribbed. Until now, series *Stipulosa* comprised 12 species in China (Wang, 1995; Lin et al., 2003). *Elatostema oppositum* differs from other species in this series in its staminate inflorescences that appear opposite or opposed to one another at a stem node (vs. the inflorescences solitary) and the pistillate inflorescences that are similarly paired or opposed to one another at stem nodes (vs. solitary). The new species is related to *E. nasutum* Hook. f. but can be distinguished by its longitudinally striate stems, both staminate and pistillate inflorescences opposite one another at stem nodes, in contrast to the alternate arrangement of leaf blades, and the 5-merous flowers. Additional differences between the new species and *E. nasutum* are given in Table 1.

The new species is distinguished by having opposite inflorescences that oppose one another at the stem nodes. This contrasts with other species in *Elatostema*, which have either solitary or paired inflorescences at the single leaf base at a stem node. The epithet *oppositum* refers to the two staminate inflorescences that oppose one another on opposite sides of the same stem node, whether or not the stem node bears a leaf. At this stem node, one staminate inflorescence is positioned at the leaf base and the second inflorescence lies opposite, across the node and positioned at the bract base when this node bears a leaf. When the node is leafless, the two staminate inflorescences arise from the bases of paired bracts and are opposed to one another across this stem node. The pistillate inflorescences appear similarly in opposing pairs at either leaf-bearing or leafless stem nodes. Staminate inflorescences are conspicuously pedunculate, which contrasts with the sessile appearance of pistillate inflorescences. The new species resembles species in *Pilea* Lindl. and *Lecanthus* Wedd. by the plants having such opposite inflorescences; however, the new taxon should be ascribed to *Elatostema* because it has more characters diagnostic for *Elatostema*, including alternate leaves and the absence of pistillate tepals. It can be observed, however, that the three genera *Pilea*, *Lecanthus*, and *Elatostema* are closely related, and it is reasonable to place them in the same tribe, Elatostemeae Gaudich.

Further studies on the new species are needed to investigate the systematic evolution of tribe Elatostemeae as well as the relationship among the different sections within *Elatostema*.

There are two types of breeding systems in *Elatostema oppositum*, monoecious and dioecious. Staminate inflorescences and pistillate inflorescences may be seen on separate staminate and pistillate branches, respectively. In monoecious plants, both staminate and pistillate inflorescences can be found together on the same stem axis, with the staminate inflorescences on the lower branches and the pistillate inflorescences above. The evolutionary trend in the breeding system of the genus *Elatostema* may therefore be characterized as the monoecious habit giving rise to dioecy. For monoecious plants, staminate and pistillate inflorescences may appear on the same branch axis, which may evolve into staminate and pistillate inflorescences segregated to different branches.

Paratypes. CHINA. **Yunnan:** Malipo Co., 1700 m, 8 July 1999, *C. I. Peng, K. F. Chung & Y. M. Shui 17479* (HAST, KUN); 1750 m, 21 Apr. 1998, *H. N. Qin, Y. Z. Wang, H. Peng & Y. F. Deng 3068* (IBSC, KUN, PE [2]), *3100* (IBSC, KUN, MO, PE [2]); 1710 m, 22 Mar. 2002, *Y. M. Shui, W. H. Chen, J. S. Sheng, S. D. Zhang & C. L. Fan 20042* (KUN), *20096* (KUN); 1940 m, 22 Mar. 2002, *Y. M. Shui, W. H. Chen, J. S. Sheng, S. D. Zhang & C. L. Fan 20137* (KUN); 1700 m, 23 Mar. 2002, *Y. M. Shui, W. H. Chen, J. S. Sheng, S. D. Zhang & C. L. Fan 20298* (KUN), *20299* (KUN), *20301* (KUN), *20361* (KUN); 1600 m, 14 May 2002, *Y. M. Shui, R. Z. Fang & W. H. Chen 21228* (PE), *21283* (KUN).

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A New Species of *Astragalus* (Leguminosae) from Northwestern Xinjiang, China

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ABSTRACT. *Astragalus baerlukensis* L. R. Xu, Zhao Y. Chang & Xiao L. Liu, a new species of Leguminosae, is described from northwestern Xinjiang, China. The new species is similar to *A. ellipsoideus* Ledeb. but differs by its notably long and filiform calyx teeth 6–8(–9) mm, oblong capitate racemes 2.5–3.5 cm long, and linear bracts 8–10 mm long. The latter taxon has shorter, subulate calyx teeth only to 3–4 mm, obovate capitate racemes 3–6 cm, and shorter, subulate-lanceolate bracts 5–6 mm long.

Key words: *Astragalus*, China, IUCN Red List, Leguminosae, Xinjiang.

The genus *Astragalus* L. (Leguminosae) consists of approximately 2500 species in the Old World, with ca. 400 species in 59 sections in China (Xu & Podlech, 2010). The species of *Astragalus* bear hair types with two kinds of attachments, either basifixed or medifixed (Farrokh, 2004). During field study on *Astragalus* in northwestern Xinjiang in May 2006, one of the present authors collected some specimens of *Astragalus* with medifixed hairs; the specimens were determined to belong to section *Laguropsis* Bunge based on the acaulescent, medifixed hairs, the calyx tubular at the beginning of anthesis but later lengthening as bladderlike and inflated, and the legumes mostly included in the calyx. However, these specimens also featured distinctly long and filiform calyx teeth that differed from those of other species in section *Laguropsis*. After careful examination of other morphological characters, we conclude that these specimens represent a new species, which is described here.

Astragalus baerlukensis L. R. Xu, Zhao Y. Chang & Xiao L. Liu, sp. nov. TYPE: China. Xinjiang: Yumin, Yumin-shuiku, on slope of Baerluke mtn., 46°37′N, 83°26′E, "clivis rupestribus in regione steppe," 900 m, 29 May 2006, *L. R. Xu & Y. Zhang 2006-105* (holotype, WUK; isotype, PE). Figure 1A, C.

Haec species *Astragalo ellipsoideo* Ledeb. affinis, sed ab eo calycis dentibus filiformibus 6–8(–9) mm (vs. subulatis 3–4 mm) longis, racemis oblongis capitatis 2.5–3.5 cm (vs. obovatis capitatis 3–6 cm) longis atque bracteis linearibus 8–10 mm (vs. subulato-lanceolatis 5–6 mm) longis differt.

Perennial herbs, 15–25 cm tall, ± acaulescent, caespitose, vegetation with medifixed, appressed white hairs; caudex strongly ligneous, divided into a pluricipital root-crown forming abbreviated stems 1–2.5 cm; stipules white, membranous, ranging from ovate on basal stems to narrowly triangular apically, 6–8 mm, adnate to petiole at base, densely pubescent. Leaves 15–25 cm; petiole 7–10 cm, stout, densely pubescent, with leaflets in 5 to 9 pairs; leaflet blades elliptic to oblong-obovate, (7–)10–15(–20) × (4–)6–8(–10) mm, acute to obtuse, often mucronate, densely pubescent with appressed white trichomes on both surfaces. Peduncles slightly shorter than leaves, 8–15 cm, stout, with densely appressed, white trichomes; bracts white, membranous, linear to very narrowly lanceolate, 8–10 × 1–1.5 mm, with mostly medifixed, white or mixed with sparse black hairs; racemes oblong capitate, 2.5–3.5 × 1.5–2 cm, each raceme congested, with 12 to 15 flowers. Calyx in anthesis tubular, 15–18(–20) mm, later bladderlike and inflated, covered with dense white and scattered black, spreading, asymmetric, medifixed trichomes; calyx teeth filiform, 6–8(–9) mm, with dense, white and scattered black, medifixed trichomes; corolla petals yellow; standard 20–24 mm, with limbs oblong-obovate, 18–20 × 7–8 mm, emarginate at apex, attenuate toward the base into a claw 2–3 mm; wings slightly shorter than standard, 19–21 mm, with limbs narrowly oblong, 6–7 mm, asymmetrically emarginate at apex, claw 1.5× as long as limb, auricle ca. 1 mm; keels slightly shorter than wings, 17–19 mm, with limbs obliquely elliptic 5–7 mm, claw 1.5× as long as limb, auricle 0.5–1 mm; stamen tube truncate at mouth; ovary subsessile, narrowly ellipsoid, with dense spreading, medifixed, white and scattered black trichomes, style glabrous. Legumes not seen.

Distribution and habitat. The new species generally occurs on gravel steppes predominated by *Caragana* Fabr., *Spiraea* L., and *Festuca* L. in

Figure 1. Comparison between the new species *Astragalus baerlukensis* L. R. Xu, Zhao Y. Chang & Xiao L. Liu and *A. ellipsoideus* Ledeb. —A, C. Holotype specimen of *A. baerlukensis* (*L. R. Xu & Y. Zhang 2006-105*, WUK). —B, D. *A. ellipsoideus* Ledeb., collected from Jimunai Co., Xinjiang, China, gravel hilly slope, 900 m, 22 May 2006 (*L. R. Xu & Y. Zhang 2006-091*, WUK).

mountainous regions of Yumin and E'min counties, at elevations of 900–1200 m.

IUCN Red List category. *Astragalus baerlukensis* is excellent forage for livestock, and its populations are severely threatened from overgrazing. Its conservation status is evaluated as Endangered (EN) according to IUCN Red List criteria (IUCN, 2001). Its distributional area is less than 500 km^2 and its known population sizes are small, with mature individuals numbering less than 2500 in each of the two populations. This suggests that the new species needs protection as an important germplasm resource.

Phenology. The new species is known to flower in May and June.

Etymology. The epithet is derived from Baerluke Mountain, located in Yumin County, Xinjiang, China, where the holotype of *Astragalus baerlukensis* was collected.

Discussion. *Astragalus baerlukensis* is similar to *A. ellipsoideus* Ledeb. in general morphology. Both species are acaulescent, have leaves with appressed, medifixed trichomes, and have yellow flowers. However, the new species differs from *A. ellipsoideus* by its notably long, filiform calyx teeth 6–8(–9) mm

(vs. subulate calyx teeth 3–4 mm), oblong capitate racemes 2.5–3.5 cm (vs. obovate capitate racemes 3–6 mm), and linear bracts 8–10 mm (vs. subulate-lanceolate bracts 5–6 mm). Both species belong to *Astragalus* sect. *Laguropsis* Bunge and have geographically disparate distributional ranges. This section has its greatest diversity in Afghanistan, China, Mongolia, Russia (Siberia), extending into Central Asia, Southwest Asia, and Eastern Europe (Xu & Podlech, 2010).

Paratypes. CHINA. **Xinjiang:** E'min, gravel steppes, Tarbaxatai mtn., 1200 m, 3 June 2006, *L. R. Xu & Y. Zhang 2006-127* (WUK).

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A Multivariate Study of *Solidago* subsect. *Junceae* and a New Species in South America (Asteraceae: Astereae)

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Abstract. A new South American species of *Solidago* L. (Asteraceae, Astereae) from Argentina, Chile, and Bolivia was identified within the subsection *Junceae* (Rydb.) G. L. Nesom. Using multivariate analyses on a matrix of 50 characteristics for 79 specimens, the distinctiveness of a South American *S. missouriensis*-like taxon was tested and determined to be statistically different from four morphologically similar North American species: *S. gattingeri* Chapm. ex A. Gray, *S. juncea* Aiton, *S. missouriensis* Nutt., and *S. pinetorum* Small. Therefore, a new South American species is proposed: *S. argentinensis* Lopez Laph. & Semple.

Key words: Argentina, Asteraceae, Astereae, biogeography, Bolivia, Chile, IUCN Red List, multivariate morphometrics, *Solidago*, South America.

In a recent taxonomic review of *Solidago* L. (Asteraceae, Astereae) in South America (Lopez Laphitz, 2009), two species of *Solidago* subsect. *Triplinerviae* (Torr. & A. Gray) G. L. Nesom were recognized: *S. chilensis* Meyen and *S. microglossa* DC. (Lopez Laphitz & Semple, 2011). In addition, the authors noticed that some specimens included among South American material were clearly morphologically very close to the North American *S. missouriensis* Nutt. Consequently, these specimens were excluded from the analysis of *Solidago* subsect. *Triplinerviae* and classified as members of *Solidago* subsect. *Junceae* (Rydb.) G. L. Nesom. Recent floristic treatments of *Solidago* subsect. *Junceae* have not included South American taxa. Only seven species have been included in *Solidago* subsect. *Junceae*, and they all occur in North America and Mexico (Semple & Cook, 2006): *S. gattingeri* Chapm. ex A. Gray, *S. juncea* Aiton, and *S. pinetorum* Small from eastern North America; *S. missouriensis* from the prairies and Rocky Mountains from southern Canada to northern Mexico; and *S. confinis* A. Gray, *S. guiradonis* A. Gray, and *S. spectabilis* (D. C. Eaton) A. Gray from the mountains of the Great Basin, the Sierras and Coastal Ranges of California, and northern Baja California Norte. *Solidago* subsect. *Junceae* can be distinguished from other *Solidago* groups by having the basal leaves often present in rosettes at flowering, the proximal-most stem leaves petiolate to attenuate-subpetiolate, and the fascicles characteristically with small linear leaves on very short lateral branches in the axes of distal stem leaves (Semple & Cook, 2006). Strigulose stem pubescence is generally absent or confined to the inflorescence.

Although Brouillet et al. (2009) were successful in resolving the phylogeny of tribe Astereae using nuclear ribosomal ITS data, Schilling et al. (2008) reported a lack of resolution in the phylogeny of *Solidago* based on sequence data due to very low levels of variation in ITS and ETS sequences. Until phylogenetically informative sequences are discovered for *Solidago*, alternative nonmolecular methods must be utilized to assess species limits within the genus. This study used multivariate morphometric analysis to assess the distinctiveness of the South American *S. missouriensis*-like plants from related North American taxa within the subsection.

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Materials and Methods

Herbarium specimens were examined from WAT, and additional specimens were borrowed from AA, CAS, DS, GH, JEPS, LP, MO, NCU, POM, RSA, TENN, and UC. Using previous analyses on the genus, descriptions of the taxa found in the literature (Semple & Cook, 2006), and personal observations, a list of the potentially useful traits was created (Appendix 1). In total, 50 morphological and floral traits were scored on specimens usually pressed during anthesis. Univariate and multivariate statistical analyses were performed using SYSTAT 10 for Windows (SPSS Inc., Chicago, Illinois, U.S.A.).

Discriminant analysis is a well-known tool in taxonomy and has been successfully used in *Solidago* (e.g., Heard & Semple, 1988; Semple et al., 1990; Cook et al., 2009; Lopez Laphitz & Semple, 2011); details of and justification for the methodology are not repeated here. Included in these analyses are tests for equality of group centroids (Wilks' lambda, Pillai's trace, and Hotelling-Lawley trace) and determination of Geisser assignment probabilities in placing each specimen a posteriori into each a priori group. Finally, a canonical discriminant analysis was used as a dimension-reduction technique to facilitate visualization of the results of the N-dimensional analyses.

A total of 627 specimens were examined, from which 220 were selected and measured for inclusion in the statistical analyses. All scored specimens were annotated with a label indicating that the specimen was included in the study. Preliminary analyses were performed including the seven taxa accepted for *Solidago* subsect. *Junceae*. Subsequently, a 79-sample matrix with the South American taxon and just the more morphologically similar central and eastern North American taxa was analyzed. The specimens assigned a priori to *S. juncea* had mainly three to 18 rays and had stems from short rhizomes or caudices. However, specimens that were identified as *S. missouriensis* had stems from elongated creeping rhizomes. Following Semple and Cook (2006), the number of rays and geographical distribution discriminated *S. pinetorum* and *S. gattingeri*. Specimens placed a priori in *S. pinetorum* came from the Piedmont and Atlantic Coastal Plain physiographic provinces in North Carolina, South Carolina, and southeastern Virginia, and had three to seven ray florets. Specimens of *S. gattingeri* came from Arkansas, Missouri, and Tennessee, and had five to eight ray florets. All of the South American individuals that had the traits of *Solidago* subsect. *Junceae* were placed a priori as *S. argentinensis* Lopez Laph. & Semple. An additional multivariate analysis was carried out on a matrix created by combining the data on *S. argentinensis* with that for *S. chilensis* and *S. microglossa* from an analysis of South American subsection *Triplinerviae* by Lopez Laphitz and Semple (2011). This was done to confirm that no specimens of *S. chilensis* had been misclassified a priori as *S. argentinensis* because small specimens of the former species can sometimes look rather similar to specimens of the latter.

Results

The results of the preliminary analysis that included all the North American taxa indicated the three far-western species, *Solidago confinis*, *S. guiradonis*, and *S. spectabilis*, were in a group morphologically distinct from the eastern North American and South American taxa. Details are available from the authors. A discriminant analysis was subsequently performed on the 79-specimen matrix to determine which characters were most useful in separating the five species-level a priori groups: one South American (*S. argentinensis*) and four North American. The four characters with the highest F values selected in a stepwise discriminant analysis (midstem leaf lengths, leaf widths, inner phyllary lengths, and stem pubescence density; Appendix 1) were included in a complete discriminant analysis in decreasing order of discriminatory power. The F matrix based on Mahalanobis distances between group centroids, and associated probabilities indicate strong overall support for the five a priori groups (Table 1) and rejection of the null hypothesis that specimens of the five a priori groups were just samples of one group. All three tests for equality of group centroids (Wilks' lambda, Pillai's trace, and Hotelling-Lawley trace) indicated that the groups were significantly different (Table 2). The highest F values were between *S. argentinensis* and the North American taxa, and the lowest between *S. gattingeri* and *S. pinetorum*. Geisser a posteriori assignment probabilities were determined, and a classification matrix and a jackknifed classification matrix for the 79 specimens were generated (Tables 3 and 4, respectively). In the classificatory analysis, 14 of the 15 specimens assigned a priori to *S. argentinensis* were assigned a posteriori to that taxon. Twelve of these specimens, including the single Bolivian collection, had Geisser assignment probabilities between 97% and 100%, and two specimens, *Buchtiero s.n.* (GH) and *C. Castagnet 150* (LP), had assignment probabilities of 75% and 82% to *S. argentinensis*; the first of these was from Chile. Only one specimen, *T. M. Pedersen 14486* (MO), was

Table 1. F statistics, $F_{0\,05}$, and associated null hypothesis P probabilities between the five putative taxa in *Solidago* subsect. *Junceae*; $P < 0.0000$ in all cases.

	a posteriori			
a priori	*argentinensis*	*gattingeri*	*juncea*	*missouriensis*
S. gattingeri	34.367			
S. juncea	30.114	8.618		
S. missouriensis	33.881	8.733	4.545	
S. pinetorum	41.639	1.662	6.721	6.101

treated as misclassified a priori and placed a posteriori in *S. missouriensis* with an assignment probability of 60%; additional assignment probabilities for the specimen were 24% to *S. juncea*, 8% to *S. pinetorum*, and 7% to *S. gattingeri*. Of the 11 specimens assigned a priori to *S. gattingeri*, six were assigned a posteriori to that taxon with Geisser assignment probabilities of 75% and 86%, and one was assigned corrected to the species with only 45% probability. Three of the four misclassified specimens were placed a posteriori in *S. pinetorum* (50%–60% probabilities), and one was classified as *S. missouriensis* (53%).

Of the 14 specimens assigned a priori to *Solidago juncea*, 10 were assigned a posteriori to that taxon; four specimens had Geisser assignment probabilities between 71% and 100%, with six specimens between 49% and 67%. The remaining three specimens were misclassified, with Geisser assignment probabilities between 2% and 40%. Of 26 specimens assigned a priori to *S. missouriensis*, 15 were placed into that taxon a posteriori. Finally, of the 13 specimens assigned a priori to *S. pinetorum*, six were placed into that taxon a posteriori, with Geisser assignment probabilities between 49% and 56%. Three of these specimens were misclassified as *S. gattingeri* and *S. missouriensis*, with Geisser assignment probabilities of 78% and 52%, respectively.

Among the North American specimens classified a priori as *Solidago gattingeri*, *S. juncea*, *S. missouriensis*, or *S. pinetorum*, 10 specimens were assigned with ambiguous a posteriori classifications (one of *S. gattingeri*, two of *S. juncea*, four of *S. missouriensis*, and three of *S. pinetorum*). Geisser assignment probabilities for the 10 specimens were divided among all four North American taxa, with no high assignment probability into a single a posteriori group.

A canonical analysis was performed and the variant scores were plotted on the first and second and on the first and third canonical axes for the five putative taxa studied (Fig. 1). The eigenvalues for the first canonical variate (3.139) accounted for 78.6% of the variation, the second (0.573) accounted for 14.4%, and the third (0.249) accounted for an additional 6.3%.

The results of analysis of *Solidago argentinensis*, *S. chilensis*, and *S. microglossa* confirmed that the three species were distinct. In the classificatory analysis, the 15 specimens treated a priori as *S. argentinensis* were all placed a posteriori in that species with 100% probability for all, including the single Chilean specimen, which resembled *S. chilensis* in general growth form.

Discussion

Based on univariate analyses, discriminant analyses, and observations of herbarium specimens, a new South American species is recognized in *Solidago* subsect. *Junceae*: *S. argentinensis*. To assess the distinctiveness of *S. argentinensis* from North American members of *Solidago* subsect. *Junceae*, four species (*S. gattingeri*, *S. juncea*, *S. missouriensis*, and *S. pinetorum*) were compared based on their similarity to specimens of the South American taxon. Specimens of *S. argentinensis* formed a statistically distinct group clearly separate from the North American species-level a priori groups in the discriminant and canonical analyses. The percentages of specimens

Table 2. Multivariate statistics and F approximations for the Wilks' lambda, Pillai's trace, and Hotelling–Lawley trace tests for the discriminant analysis of the five putative taxa.

Statistic	Value	F values	*df*	P-tail
Wilk's lambda	0.119	13.476	16, 214	0.0000
Pillai's trace	1.351	9.351	16, 292	0.0000
Hotelling-Lawley trace	3.991	17.088	16, 274	0.0000

Table 3. Classification matrix obtained by classificatory discriminant analysis of the five putative taxa in *Solidago* subsect. *Junceae*. The number of specimens for each putative taxon are given in row categories and summed as columns.

	a posteriori					
a priori	*argentinensis*	*gattingeri*	*juncea*	*missouriensis*	*pinetorum*	% correct
S. argentinensis	14	0	0	1	0	93%
S. gattingeri	0	6	1	1	3	55%
S. juncea	0	1	9	2	2	64%
S. missouriensis	1	1	4	15	4	60%
S. pinetorum	0	2	1	3	7	54%
Totals	15	10	15	22	16	65%

correctly assigned a posteriori to *S. argentinensis* in the classificatory analysis and the Geisser assignment probabilities of individual specimens were generally higher than for placements and assignment probabilities for specimens of the four eastern North American species included in the study. The one specimen not placed a posteriori in *S. argentinensis* (*Pedersen 14486*, MO) was from Chubut Province, Argentina, in the southern portion of the species range, but was not overall morphologically distinct from other specimens of *S. argentinensis*. The combination of traits, however, made it aberrant for the species. It was placed a posteriori with 100% probability into *S. argentinensis* in the analysis comparing *S. argentinensis*, *S. chilensis*, and *S. microglossa*, the three native species of *Solidago* in South America. The results provide strong support for recognizing the South American plants as members of a separate, previously undescribed species in subsection *Junceae*. The results also indicate that the North American species can be very similar morphologically at times. The small number of specimens scored and the similarities in overall morphology among them are some of the factors that could be affecting the weak classification of these North American taxa. Further sampling is needed for these North American taxa before taxonomic conclusions about their status can be reached.

Solidago subsect. *Junceae* had not been reported in South America until recently by Lopez Laphitz (2009) and Lopez Laphitz and Semple (2011). This can be explained by the morphological similarities between *S. argentinensis* and another South American taxon, *S. chilensis*, which belongs to subsection *Triplinerviae*, such as the sparse indument on the inflorescence and upper stems, as well as by the lack of accurate or comprehensive taxonomic keys for the genus *Solidago* in South America (e.g., Sancho & Ariza Espinar, 2003). In addition, the overlapping distribution of *S. argentinensis* and *S. chilensis* in the Patagonian region and their probable sequential flowering season are also potential factors in the previous misidentification of the new species. Unlike North American members of subsection *Triplinerviae*, dwarf *S. chilensis* specimens can be as small as 15–20 cm tall, which would not be uncommon in *S. missouriensis* on the high plains in North America, but is at the very low end of the range in stem height of the *S. argentinensis* specimens examined. Thus, a usually reliable character such as stem height is sometimes misleading in South American species of *Solidago*.

While the introduction of *Solidago* into South America has not been studied in detail, the chance long-distance transport of the fruit propagules attached to the feathers of migrating birds is possible (Alan Graham, e-mail communication to J. C.

Table 4. Jackknifed classification matrix obtained by classificatory discriminant analysis of the five species-level a priori groups in *Solidago* subsect. *Junceae*.

	a posteriori					
a priori	*argentinensis*	*gattingeri*	*juncea*	*missouriensis*	*pinetorum*	% correct
S. argentinensis	14	0	0	1	0	93%
S. gattingeri	0	6	1	1	3	55%
S. juncea	0	1	8	3	2	57%
S. missouriensis	1	1	4	15	4	60%
S. pinetorum	0	3	1	3	6	46%
Totals	15	11	14	23	15	63%

Semple). The likely recent human-aided dispersal of *S. chilensis* back to multiple locations in the Northern Hemisphere (Lopez Laphitz, 2009 [West Indies]; Silva et al., 2009 [Madeira]) demonstrates that long-distance dispersal is not an obstacle in the genus. The relatively small sample of South American *S. argentinensis* collected between 1903 and 1986 provides little evidence for its point of origin. In general appearance, *S. argentinensis* resembles *S. missouriensis*; the two differ in stem pubescence, leaf size, and phyllary traits, but all other traits suggest a close relationship of the two species. A putative close relative of *S. chilensis* (*S. juliae* G. L. Nesom) and one of *S. argentinensis* (*S. missouriensis*) occurs in the same general area of northern Mexico today (Lopez Laphitz & Semple, 2011).

Solidago argentinensis Lopez Laph. & Semple, sp. nov. TYPE: Argentina. Mendoza: San Rafael, Río Salado Superior entre Arroyos Vertientes Amarillas y Los Moros, 1940 m.s.n.m., 29 Jan. 1966, *Ruiz Leal 24529* (holotype, LP). Figure 2.

Haec species *Solidagini missouriensi* Nutt. accedens, sed ab ea caulibus proximaliter sparsim distaliter dense strigulosis differt.

Herbaceous perennials from short to long rhizomes; stems erect, 18–50 cm tall, glabrate at the base, with increasing hair density distally, strigulose. Basal cauline leaves sometimes present at flowering and relatively large; midstem to distal cauline leaves much reduced distally, often subtending clusters (fascicles) of small lateral branch leaves; lower stem leaves petiolate, 20–80 mm including petiole, 3–14 mm wide, margin serrations 0 to 7; midstem leaves sessile, rapidly reduced upward, oblanceolate to lanceolate, 25–65 × 3–12 mm, margin serrations 0 to 5; upper and inflorescence stem leaves sessile, reduced lanceolate to linear, 12–58 × 0.5–5 mm. Inflorescences with heads paniculiform (pyramidal), nodding or secund, 5–21 × 2–6 cm; involucres 3.5–5.5 mm high; phyllaries in 3 or 4 series, the outer series ovate, the inner ones linear-ovate to oblong. Ray florets 6 to 19, strap 1–3 × 0.2–0.7 mm; disc florets 5 to 19, corollas 3–4.8 mm, lobes 0.6–1.5 mm. Cypsellae obconic, 0.5–1.2 mm; pappus bristles 3.2–5 mm. Chromosome number unknown.

Distribution and habitat. *Solidago argentinensis* is found from the Patagonian region of Argentina (Chubut, Neuquén, and Río Negro provinces) north to Mendoza Province. It has been collected from Juncal, Chile, and Valle de Cochabamba, Bolivia.

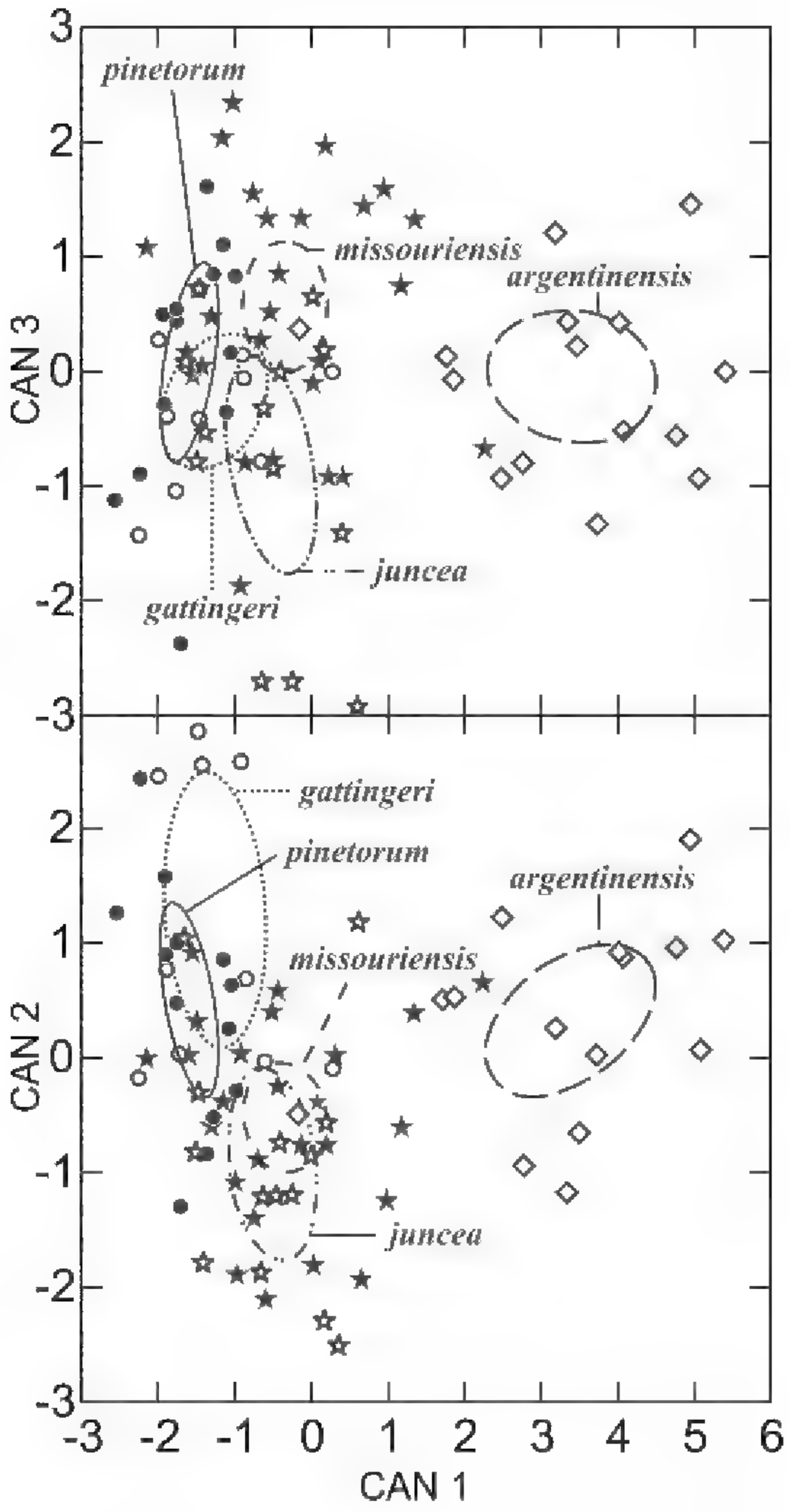

Figure 1. Plot of the first versus the second and the first versus the third canonical scores for 79 specimens of *Solidago* subsect. *Junceae* (matrix and analysis available from the authors). 95% confidence ellipses are indicated by broken and solid lines, with *S. argentinensis* represented by shaded diamonds, long-dash line ellipse; *S. gattingeri* by circles, dotted line ellipse; *S. juncea* by open stars, dot-dash line; *S. missouriensis* by solid stars, short-dash line ellipse; and *S. pinetorum* by dots, solid line ellipse.

IUCN Red List category. The new species is evaluated here as Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001).

Phenology. *Solidago argentinensis* has been collected in flower from January to early March.

Paratypes. ARGENTINA. **Chubut:** Nueva Lubecka, *T. M. Pedersen 14486* (MO). **Neuquén:** entre La Rinconada y Junín de los Andes, *A. L. Cabrera & J. Crisci 19130* (MO); Piedra Pintada, *C. Castagnet 150* (LP); Traful Norte, *A. Soriano 84* (LP); entrada de camino al Huechulafquen desde Junin de los Andes, *M. Lazago 3377* (LP); entre La

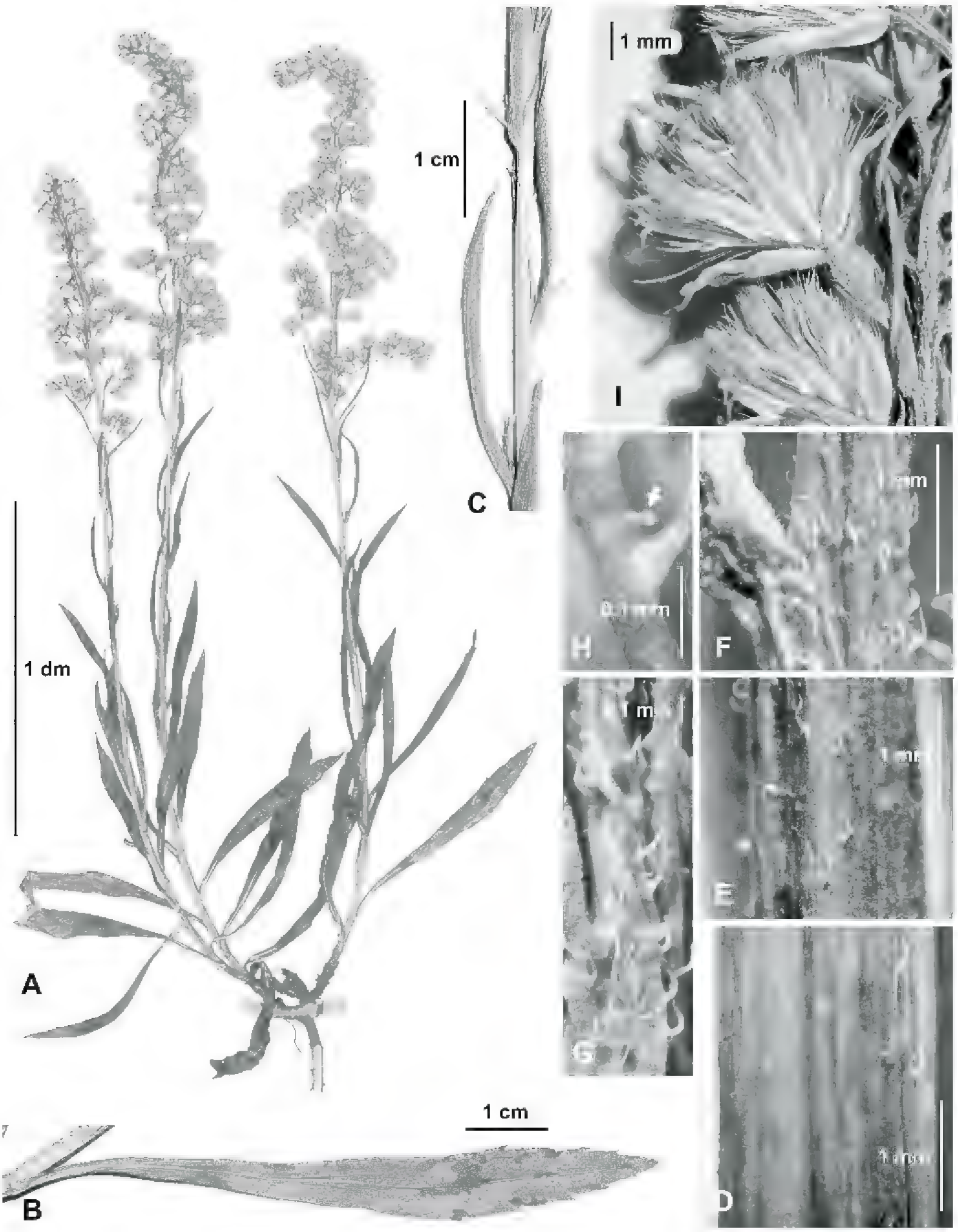

Figure 2. Holotype collection of *Solidago argentinensis* Lopez Laph. & Semple (*Ruiz Leal 24529*, LP). —A. Fertile shoots. —B. Lower stem leaf. —C. Middle to upper stem with lateral small lateral branch leaves. D–H. Stem and peduncle pubescence. —D. Lower stem, sparsely strigose. —E. Upper stem. —F. Mid inflorescence main stem. —G. Upper primary inflorescence axis. —H. Peduncle, base of hair and minute stipitate gland (arrow). —I. Inflorescence heads.

Rinconada y Junín de los Andes, *A. L. Cabrera & J. Crisci 19130* (LP). **Río Negro:** Destacamento Militar (Parque Nacional Nahuel Huapi), *R. De Barba 301* (AA); Puerto Pañuelo, region of Lago Nahuel Huapi, *I. Rafael Cordini 121* (LP); camino al Tronador, *C. Castagnet 74* (LP); San Carlos de Bariloche, *A. Burkart 6586* (LP), *A. Corte 291* (LP). BOLIVIA. Valle de Cochabamba, *J. Steinbach 8795* (GH). CHILE. Juncal, 1903, *O. Buchtiero s.n.* (GH).

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Appendix 1. Morphological traits scored for *Solidago argentinensis* and related taxa from North America. Traits marked with an asterisk (*) were not included in discriminant analyses because they correlated strongly (correlation coefficient of $r > 0.7$) with another trait or the trait could not be scored on many specimens. Traits marked with a pound symbol (#) were also excluded because they were used to identify a priori groups in some analyses.

*Stem height (cm); stem hairs: number of hairs counted on 1 mm on basal stem; *stem hairs: number of hairs counted on 1 mm on midstem; *stem hairs: number of hairs counted on 1 mm on upper stem; stem hairs: number of hairs counted on 1 mm on inflorescence stem.

*Hair length (mm) measured on basal stem; *hair length (mm) measured at midstem; *hair length (mm) measured on upper stem; *hair length (mm) measured on inflorescence stem.

*Basal leaf length (cm) measured from leaf base to tip; *basal leaf width (cm) measured at widest point; *basal leaf measured from widest point to tip; *basal leaf margins: number of serrations on one side of leaf margin.

Midstem leaf length (cm) measured from leaf base to tip; midstem leaf width (cm) measured at widest point to tip; *midstem leaf measured from widest point to tip (cm); #midstem leaf margins: number of serrations on one side of leaf.

Upper stem leaf length (cm) measured from leaf base to tip; upper stem leaf width (cm) measured at widest point; *upper stem leaf measured from widest point to tip (cm); #upper stem leaf margins: number of serrations on one side of leaf.

Inflorescence leaf length (cm) measured from leaf base to tip; inflorescence leaf width (cm) measured at widest point; *inflorescence leaf measured from the widest point to tip; #inflorescence leaf margins: number of serrations on one side of leaf.

Inflorescence length (cm) measured from base to tip; inflorescence width (cm) measured at widest point; length of the longest branch in the inflorescence (cm); **#distance between the first two branches in the base of the inflorescence; inflorescence angle formed between main stem and the branch measured from inflorescence.

*Height of involucre (cm).

Outer phyllary length (mm) measured from phyllary base to tip; outer phyllary width (mm) measured at widest point; *outer phyllary measured from widest point to tip (mm); outer phyllary vein number.

Inner phyllary length (mm) measured from phyllary base to tip; inner phyllary width (mm) measured at widest point; *inner phyllary measured from widest point to tip (mm); inner phyllary vein number.

Ray florets: number per head; ray lamina length (mm) measured from corolla tube apex to lamina tip; *ray lamina width (mm) measured at widest point; *cypsela length (mm) at anthesis; ray floret pappus length (mm).

Disc florets: number per head; disc corolla tube length (mm) measured from base to tip of corolla tube; disc floret cypsela length (mm) at anthesis; *disc floret corolla limb length (mm); disc corolla lobe length (mm); cypsela: pappus length (mm).

New Species and Notes in the Genus *Dioclea* s.l. (Fabaceae, subtribe Diocleinae)

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Abstract. Seven new species are described in *Dioclea* Kunth (Fabaceae, Diocleinae). *Dioclea ovalis* R. H. Maxwell is described from Colombia and assigned to series *Dioclea*. Within subgenus *Dioclea*, the new series *Virgatae* R. H. Maxwell is created, with the new species *D. vallensis* R. H. Maxwell included from Colombia. Two sections established by Bentham are raised to subgenera status, as the new combinations *Dioclea* subg. *Pachylobium* (Benth.) R. H. Maxwell and *Dioclea* subg. *Platylobium* (Benth.) R. H. Maxwell. Within subgenus *Platylobium*, *D. hispidimarginata* R. H. Maxwell is described from Peru. Within subgenus *Pachylobium*, four new species are described: *D. apiculata* R. H. Maxwell from Bolivia, *D. circinata* R. H. Maxwell from Colombia, *D. haughtii* R. H. Maxwell from Colombia and Venezuela, and *D. jamesonii* R. H. Maxwell from Ecuador. *Dioclea macrocarpa* Huber is designated as lectotype for *Dioclea* sect. *Macrocarpon* Amshoff.

Key words: *Dioclea*, Diocleinae, Fabaceae.

Bentham (1837) divided *Dioclea* Kunth (Fabaceae, Diocleinae) into section *Eudioclea* Benth. and section *Pachylobium* Benth. and described 11 new species. Bentham (1859) later added one new species, and new collections with fruit enabled him to segregate a third section, section *Platylobium* Benth. To separate his three sections, Bentham (1837, 1839) used differences in stipule size, whether stipules extend below insertion (produced); alternate anther size, as smaller (effoetae) or uniform; the number of ovules; and legume shape, number of seeds, and hilum shape and length relative to the seed size. I am, in general, following Bentham's selection of section characters in raising sections to subgenera, and the two combinations *Dioclea* subg. *Platylobium* (Benth.) R. H. Maxwell and *Dioclea* subg. *Pachylobium* (Benth.) R. H. Maxwell are established. Amshoff (1939) named a new section, section *Macrocarpon* Amshoff, containing *D. huberi* Ducke and *D. macrocarpa* Huber, two species with uniform anthers and several seeds evenly distributed in the fruit. These characters did not fit into Bentham's section *Platylobium*. New species, series, sections, and subgenera herein represent some originally cited in my doctoral dissertation (Maxwell, 1969).

Lackey (1981), in his key, split *Dioclea* into two groups: (1) *Dioclea* sect. *Dioclea* and (2) *Dioclea* sect. *Pachylobium* and *Dioclea* sect. *Platylobium*. Pollen evidence (Kavanagh & Ferguson, 1981) strengthens the independence of these two subgroups. Furthermore, two articles (Maxwell & Taylor, 2003; Queiroz et al., 2003) show the existence of separate clades of species in *Dioclea*. Species within *Dioclea* (operational taxonomic units [OTUs]) were selected in Maxwell and Taylor (2003) to represent the three subgenera and the sections or series in Maxwell (1969). Maxwell and Taylor (2003) stated that the data clearly show the existence of two separate clades of species in *Dioclea*. Queiroz et al. (2003) found a *Pachylobium* clade and a *Cymbosema* Benth.–*Dioclea* clade, with *Dioclea* species in the latter all within *Dioclea* sect. *Dioclea* and distinct from the *Pachylobium* clade. I assert that the *Dioclea* species in the *Cymbosema–Dioclea* clade (Queiroz et al., 2003) and *Dioclea* subg. *Dioclea* (Maxwell & Taylor, 2003) represent a distinct genus.

Varela et al. (2004: 61), using spacer sequences from nuclear ribosomal DNA, found the "region sequences are congruent with the morphologically defined subgenera (Maxwell, 1969, unpublished Ph.D. dissertation), being well supported by high bootstrap values."

Taylor, Queiroz, and Maxwell have agreed to collaborate to define or redefine the status of species groups within *Dioclea* s.l. DNA analysis of *Dioclea* species is ongoing at Indiana University Southeast, and the results will be incorporated with other available data. We are aware of the genus *Platylobium* Sm. (Smith, 1793), and if *Dioclea* subg. *Platylobium* is ultimately raised to genus level, a new name will be chosen.

Dioclea is a group of ca. 60 species centered primarily in the New World tropics. However, *D. reflexa* Hook. f. (= *D. hexandra* (Roxb.) Mabb.), described from West Africa, as well as *D. wilsonii* Standl., from Central America, contribute sea beans, which are components of oceanic drift found on many

Old and New World islands (Muir, 1937; Gunn, 1968; Gunn et al., 1976).

I have substituted the term brachyblast for tubercle, or short shoot, the outgrowth from the inflorescence upon which *Dioclea* flowers develop. Floral bracts are first-order innovations at the base of the brachyblast, bractlets are second-order at the base of the flower pedicels, and bracteoles are third-order bracts paired at the base of the flower calyces (Tucker, 1987). I also rely heavily on fruit and seed characters, when these are known, as suggested by Corner (1951).

Dioclea Kunth, Nov. Gen. Sp. [H.B.K.] 6: 342 (folio ed.). [12 July] 1824 [quarto ed.: 6(29): 437. Sep. 1824]. TYPE: *Dioclea sericea* Kunth (lectotype, designated by Britton & Wilson [1924: 418]).

Dioclea Spreng., Syst. Veg. (ed. 16) [Sprengel] 1: 502, 556. 1824 [1825], nom. illeg. superfl. TYPE: *Dioclea hispidissima* (Lehm.) Spreng. [Boraginaceae].

Hymenospron Spreng., Syst. Veg. (ed. 16) [Sprengel] 4: 283. 1827. TYPE: *Hymenospron apurense* Spreng. (= *Dioclea apurensis* Kunth; — *Hymenospron sericeum* Spreng. [= *Dioclea sericea* Kunth]).

Crepidotropis Walp., Linnaea 14: 296. 1840. TYPE: *Crepidotropis brasiliensis* Walp.

Lepidamphora Zoll. ex Miq., Fl. Ned. Ind. 1(1): 217. 1855. TYPE: *Lepidamphora volubilis* Zoll., nom. inval., sine Latin diagnosis [— *Dioclea javanica* Benth.].

I. **Dioclea** subg. **Dioclea** Kunth, Nov. Gen. Sp. [H.B.K.] 6(28): 342 (folio ed.). [12 July] 1824 [quarto ed.: 6(29): 437. Sep. 1824]. *Dioclea* sect. *Eudioclea* Benth., Comm. Legum. Gen. 2: 69. 1837. TYPE: *Dioclea sericea* Kunth (lectotype, designated by Britton & Wilson [1924: 418]).

Woody vines, trailing, climbing, or becoming shrubby in open habitat. Leaves trifoliolate, leaflets with primary lateral veins in 5 to 8 pairs; stipules ovate, lanceolate, not produced, to ca. 4 mm. Inflorescences axillary, pseudoracemose; floral bracts to ca. 4 mm; bracteoles variable, smaller, mostly ovate, oval to lanceolate 1.5–7 × 1–4 mm, or larger oval to suborbicular, 6–15 × 6–10 mm. Flowers 1.3–5.5 cm, petals membranous; calyx 4-lobed, the upper lobe apex entire; standard ecallose, apex margin puberulent, with basal, collarlike auricles usually extending down the claw; wings obliquely oblong, oblanceolate to obovate, frequently with a spur, usually puberulent, smaller or equal to the keel petals; keel petals obliquely oblong to somewhat rectangular or oblong, erostrate, the upper margin with fimbriate, dentate, or serrate sections, rarely entire, glabrous; stamens 10, glabrous, mostly pseudomonadelphous, very rarely the vexillary free; anthers 10, monomorphic; pistil geniculate, or distally ascending, exserted, ovary 5- to 15-ovulate, ovary disc mostly entire (disc collar), style glabrous distally, stigma terminal, capitate, small. Fruit flat, dry, linear to oblong, dehiscent, upper margin mostly straight, upper suture with a closely parallel rib or wing to each side, without extra wings or ribs, the lower margin naviculate, lower suture indistinct or swollen (flanged); seeds small, somewhat oblong to elliptic, flat, hard, smooth, 7–14 × 4–8.5 × 2–3 mm, hilum linear, ca. 7–14 mm, encircling nearly 1/2 the circumference of the seed.

Discussion. Two species were described by Kunth, *Dioclea apurensis* and *D. sericea*. *Dioclea apurensis* (syntype, P-Bonpl.) has fruit but lacks flowers. Both species exhibit characters that place them in Bentham's section *Eudioclea*. Bentham (1837) characterized his section *Eudioclea* by obtuse, beakless keel petals; wing petals smaller than or equal in length to the keel petals; upper suture of the legume narrowly two-winged; stipules ovate-lanceolate, small, and not produced below insertion; and uniform anthers. These characters are still valid and are incorporated in the subgenus description above.

Dioclea Kunth sect. **Dioclea**.

Ia. Dioclea Kunth ser. **Dioclea**.

Bracteoles small, mostly ovate, ca. 1.5–2.5 × 0.5–3 mm (except lanceolate, to ca. 7 × 4 mm in the new species *Dioclea ovalis*); flowers mostly 1.5–2.5 cm (except 30–35 mm in *D. albiflora* R. S. Cowan); pedicels mostly < 5 mm (except ca. 7 mm in *D. albiflora*); standards reflexed; calyx pubescent (except somewhat substrigose in *D. albiflora*); pistils with ovary, proximal portions of the style mostly straight, distally ascending; fruit usually < 2 cm wide.

1. Dioclea ovalis R. H. Maxwell, sp. nov. TYPE: Colombia. Cundinamarca: Pacho, Hac. Patasía, 1800–2000 m, 8 Feb. 1948, *L. U. Uribe 1648* (holotype, US; isotype, COL). Figure 1.

Haec species a congeneris *Diocleae* Kunth subg. *Diocleae* sect. *Diocleae* ser. *Diocleae* bracteolis lanceolatis usque ad 7 × 3.5 mm distinguitur.

Climbing vine or subshrub, stems terete, with sparse, canescent to tomentose pubescence. Leaves with leaflets broadly oval to suborbicular, terminal leaflets to ca. 11 × 7.5 cm, lateral leaflets to ca. 9.5 × 6.5 cm, adaxial lamina surface tomentulose, abaxial surface curly villous, with a nigrescent reticulum, apices obtuse, bases round, primary lateral veins in

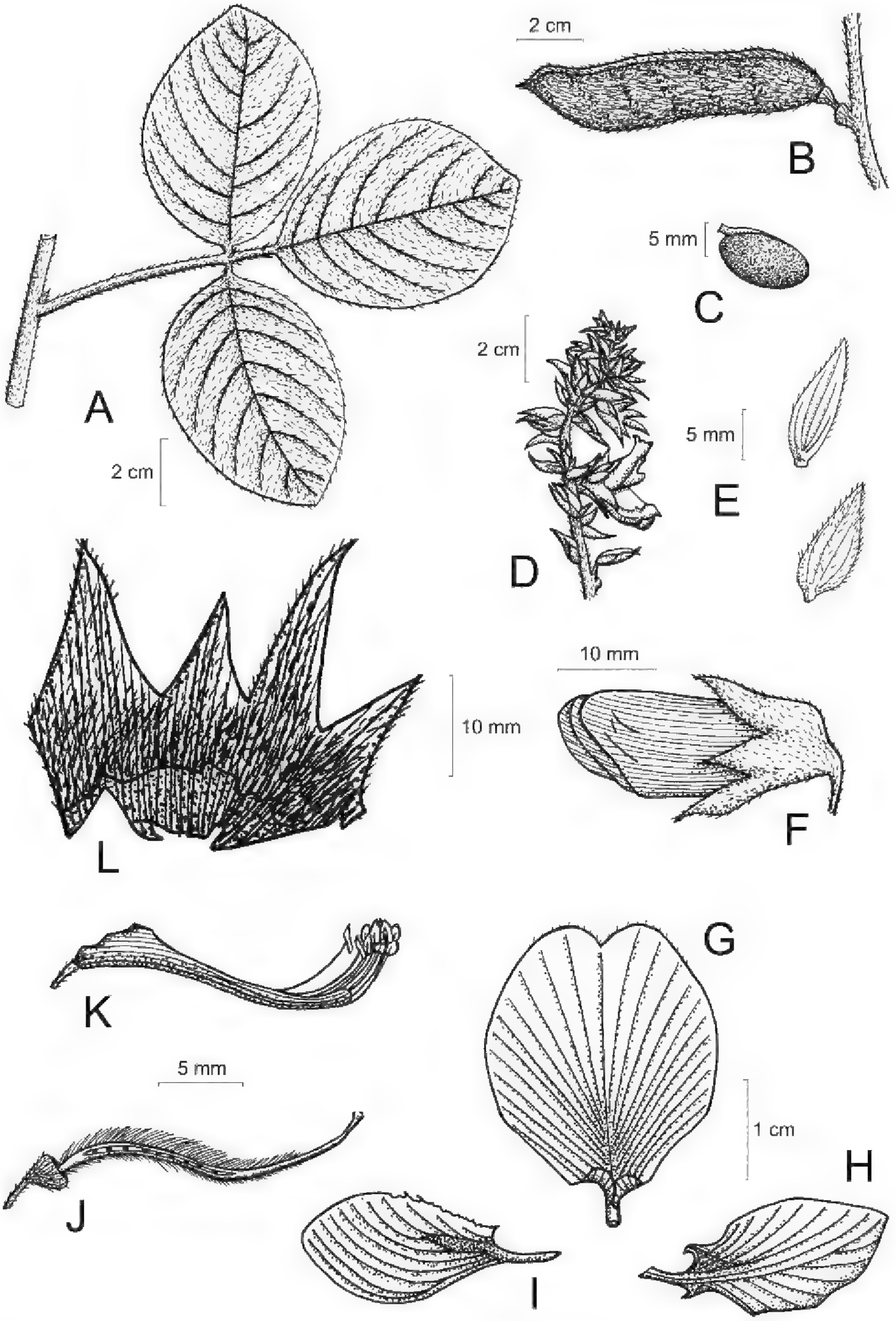

Figure 1. *Dioclea ovalis* R. H. Maxwell. —A. Habit with leaf and portion of stem. —B. Fruit. —C. Seed. —D. Inflorescence, top portion. —E. Bracteoles, internally glabrous (top), externally fuscous villous (bottom). —F. Flower bud. —G. Standard. —H. Wing petal. —I. Keel petal. —J. Gynoecium. —K. Androecium. —L. Calyx, inner surface with fuscous villous indument. A–L drawn from the holotype *L. U. Uribe 1648* (US).

ca. 8 pairs; petioles and rachis canaliculate, petiole ca. 5.5 cm, rachis ca. 5 mm, light fuscous tomentose; stipules triangular, ca. 4 × 2 mm, villous outside, glabrous inside, persistent; stipels setiform, ca. 1.5 mm, ciliate, persistent. Inflorescences axillary or terminal, single, unbranched, ca. 50 cm, terete below, ridged above, stout, light fuscous tomentose; florate 1/3–2/3 the length; brachyblasts sessile; floral bracts triangular, ca. 2.5 × 1.5 mm, strigose outside, glabrous inside, persistent; bracteoles ovate to lanceolate, to ca. 7 × 2.5–3.5 mm, fuscous, subvillous outside, glabrous inside, caducous; bractlets ca. 3 × 2 mm, subvillous outside, glabrous inside; pedicels ca. 4 mm. Flowers to 2.7 cm, buds acuminate; calyx tube ca. 7 mm, light fuscous villous pubescence outside, fuscous villous inside, lobes lanceolate, upper lobe entire, 8–11 × ca. 8 mm basally, lateral lobes ca. 7 × 5 mm, lower lobe ca. 11 × 5 mm; petals membranous; standard reflexed, purple, broadly ovate, ca. 27 × 23 mm, apex emarginate, puberulent, ecallose, basally biauriculate, claw ca. 4 mm; wings broadly oblanceolate-elliptic, ca. 20 × 12 mm, apex puberulent, spur and auricle sharp, downcurved, claw ca. 5 mm; keel petals obliquely oblong, ca. 19 × 10 mm, weakly auriculate to exauriculate, upper margin serrate basally, with deeper incisions medially, diminishing in depth distally, claw ca. 5 mm; stamens pseudomonadelphous, glabrous, anthers 10, uniform, vexillary filament free basally ca. 3.5 mm, lightly joined to the sheath; pistil ca. 18 mm, distally ascending, style glabrous ca. 6 mm distally; ovary ca. 9 mm, ca. 9-ovulate, villous, with a disc collar. Fruit compressed, oblong, ca. 9 × 2 × 0.5 cm, dehiscent, exocarp with persistent, ferruginous pubescence, pedicel attached toward the base, upper suture with thin wings ca. 3 mm to either side, lower margin slightly swollen, ca. 7-seeded; seeds somewhat elliptic, ca. 11 × 7 × 3 mm, red-brown, sparsely mottled, hilum ca. 10 mm.

Distribution and habitat. This species is found at altitudes between 1200 and 2000 m, climbing on riverbanks and the sides of ravines in Colombia.

Discussion. *Dioclea ovalis* is named for the oval shape of the leaflets. *Dioclea ovalis* specimens may be found among those determined as *D. lehmannii* Diels and *D. guianensis* Benth. var. *velutina* Benth. *Dioclea lehmannii* (type, *Lehmann 5754* [believed destroyed at B]; isotypes, F, US) is distributed at low altitudes in the coastal plain swamps and lower rainforest of Ecuador (Svenson, 1946: 420). *Dioclea guianensis* var. *velutina* (type, *Hinds s.n.*, K), from Puná Island, Guayaquil, Ecuador, shares a dark calyx tube with somewhat ferruginous pubescence, caducous lanceolate bracteoles, and long acuminate calyx lobes. *Dioclea ovalis* is considered a high-altitude species of the series with the longest lanceolate bracteoles. A reexamination of the isotype of *D. lehmannii* at F enabled me to recognize *D. ovalis* as a new species (Maxwell, 1969: 414–418).

Paratypes. COLOMBIA. **Cundinamarca:** Pandi, 8 Feb. 1876, *E. André 1497* (NY); Sasaima, *Bro. Estanislao 71* (US); Pacho, Río Patasía, 26 May 1947, *L. U. Uribe 1567* (COL); Cumaca, Calandaima, Laguna de la Cajita, *L. U. Uribe 5036* (COL).

Ib. Dioclea ser. **Virgatae** R. H. Maxwell, ser. nov. TYPE: *Dioclea virgata* (Rich.) Amshoff, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 52: 69. 1939. [= *Dolichos virgatus* Rich., Actes Soc. Hist. Nat. Paris 1: 111. 1792.]

Haec series a ceteris seriebus *Diocleae* Kunth subg. *Diocleae* floribus (2)2.5 5.5 cm longis, pedicellis plerumque > 5 mm longis (praeter illos in *D. apurensis* Kunth), vexillo reflexo vel patente, calyce plerumque glabro atque ovario proximaliter recto deorsum curvato deinde geniculato vel sigmoidali distinguitur.

Bracteoles large, broadly elliptic to suborbicular (except ca. 3.5 × 3 mm in *Dioclea burkartii* R. H. Maxwell and *D. apurensis*; ca. 8 × 3 mm, lanceolate-elliptic in *D. fimbriata* Huber); flowers (2–)2.5–5.5 cm, pedicels mostly > 5 mm (except *D. apurensis*); standards reflexed (except spreading in the ornithophilous species *D. fimbriata* and *D. macrantha* Huber [Queiroz et al., 2003: 317]); calyx glabrous (except occasionally strigose in *D. apurensis* and the novel *D. virgata* var. *crenata* R. H. Maxwell); pistils with ovary, proximal portions straight, mostly downcurved then geniculate, occasionally somewhat sigmoidal; fruit large (for section), mostly 2–2.5(–3) cm wide.

1. Dioclea vallensis R. H. Maxwell, sp. nov. TYPE: Colombia. Valle del Cauca: Pacific coast, Río Cajambre, 5–80 m, 5–15 May 1944, *J. Cuatrecasas 17499* (holotype, US; isotype, F). Figure 2.

Haec species *Diocleae virgatae* (Rich.) Amshoff magnitudine bracteolarum similis, sed ab ea foliolis membranaceis vel papyraceis apice longe acuminatis, carinae margine superiore serrulato integrove (nec fimbriato) et fructu 2 3 cm lato differt.

Vines, twining, high climbing, stems terete, with sparse upcurved white hairs or glabrate. Leaves with leaflets membranous or papyraceous, ovate, terminal leaflets frequently broadly ovate, 8–14.5 × 4.5–7.5 cm, lateral leaflets 7–11 × 4–7 cm, slightly

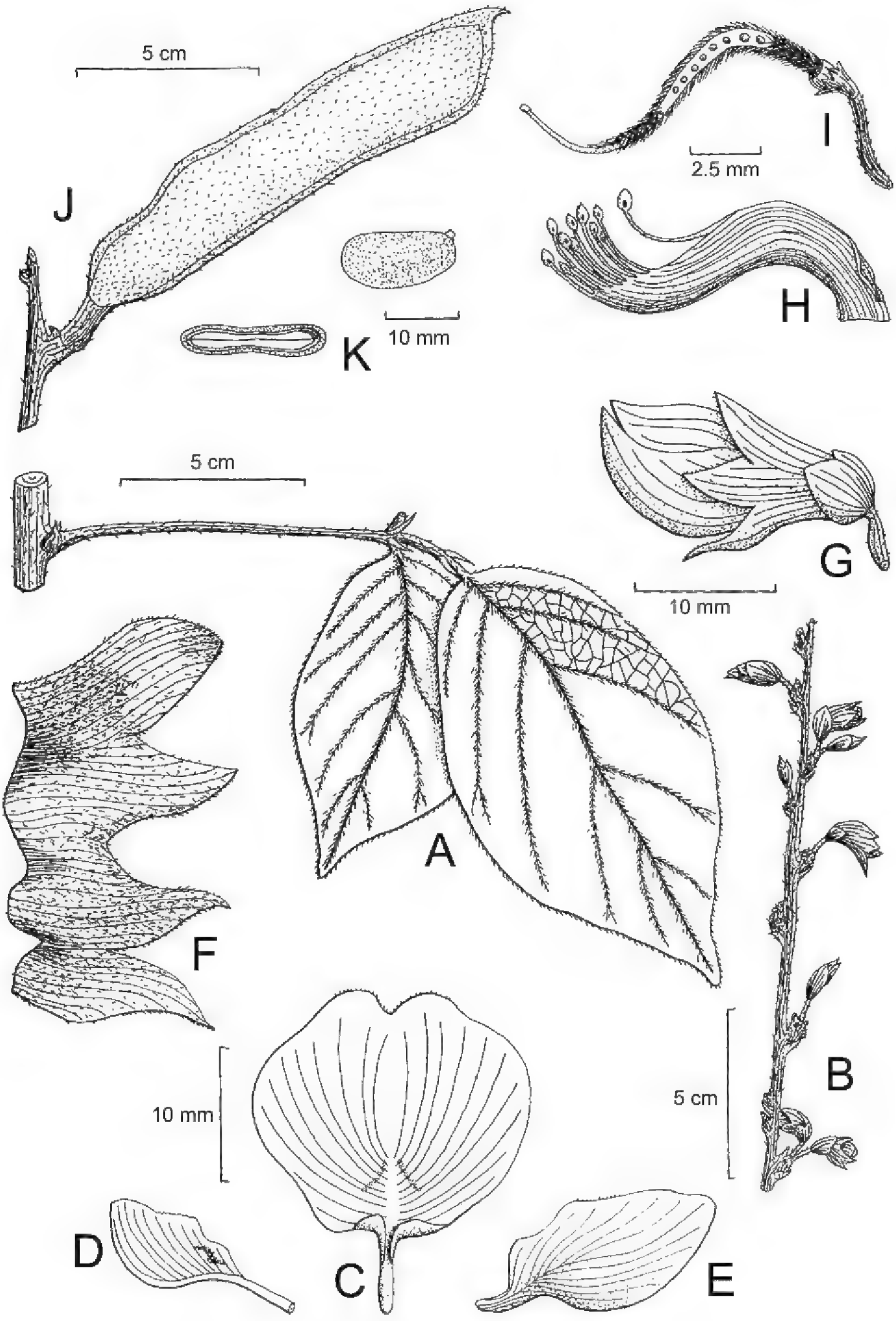

Figure 2. *Dioclea vallensis* R. H. Maxwell. —A. Habit with terminal and lateral leaflets, with one lateral leaflet removed. —B. Portion of inflorescence. —C. Standard. —D. Keel petal. —E. Wing petal. —F. Calyx, inner surface (to same scale as C–E). —G. Flower bud. —H. Androecium. —I. Gynoecium. —J. Fruit. —K. Seeds, hilum view (at left) and side view (at right). A–J drawn from the holotype *Cuatrecasas 17499* (US); K from *Cuatrecasas 15257* (US [sheet 2]).

asymmetrical, apices acuminate with drip tips to 1.5 cm, bases rounded, occasionally narrowly truncate or slightly cordate, adaxial lamina surface glabrate except the primary veins, abaxial surface sparsely pubescent with erect, curved, canescent pubescence, primary lateral veins in 5 to 7 pairs; petiole and rachis slender, with sparse strigose pubescence, petioles to ca. 10 cm, rachis 8–16 mm; stipules not produced below insertion, acute or triangular, to 3 mm; stipels setiform, to 4 mm, glabrous, persistent. Inflorescences axillary, single or double, unbranched, 30–65 cm, terete, with short, ascending, curly, canescent pubescence, florate ca. 1/2 the length; brachyblasts sessile, somewhat blocky-elongate; floral bracts acute or ovate, ca. 2.5 mm, glabrate, persistent; bracteoles ovate, ca. 6–10 × 6–8 mm, semi-persistent or persistent, glabrous or sparsely puberulent; pedicels to ca. 6 mm. Flowers to ca. 2.3 cm; calyx tube ca. 8 mm, glabrate, occasionally pubescent along the median ridges, upper lobe obtuse, ca. 7 mm, entire, lateral lobes acute, ca. 6 mm, lower lobe lanceolate, ca. 7 mm; standard reflexed, lilac, purple, or violet, with the lamina obovate or orbicular, emarginate, apex puberulent, to ca. 18 × 19 mm, claw ca. 6 mm; wings somewhat obliquely oblong, to ca. 15 × 8 mm, auricle blunt, without a spur, claw ca. 5 mm; keel petals blocky, oblong to somewhat obliquely oblong, ca. 9 × 6 mm, claw ca. 5 mm, upper median margin mostly shallowly serrate, occasionally entire; stamens 10, glabrous, vexillary filament free at the base ca. 4 mm, pseudomonadelphous, or vexillary occasionally completely free, anthers 10, perfect; pistil gently downcurved with an ascending style, or sigmoidal, style proximally bearded, distally glabrous ca. 4 mm; stigma terminal, capitate; ovary ca. 7 mm, with a basal disc collar, ca. 8-ovulate, with whitish tomentose pubescence < 1 mm. Fruit flat, oblong, pedicel attachment at the lower margin, to ca. 12 × 2–3 × 0.4 cm, eventually dehiscent, with stiff, erect, canescent pubescence changing to ferruginous, fugacious, then glabrate; upper suture paralleled by a wing ca. 2.5 mm to either side, lower margin flanged, 5- to 9-seeded; seeds smooth, shining, hard, dark brown, occasionally with darker mottling, ca. 14 × 8.5 × 2.5 mm, hilum ca. 14 mm, encircling nearly 1/2 the circumference of the seed.

Distribution, habitat, and phenology. This species is found in swampy forests, woods, wooded cliffs, and valleys along rivers. *Dioclea vallensis* has been collected in Chocó and Valle del Cauca departments, Colombia, west of the Cordillera Occidental, at low altitudes from just above the high tide mark along the Pacific coast up to 250 m; it flowers from October to May.

Discussion. *Dioclea vallensis* is named after its geographic location and shares similar characters of the series with the common *D. virgata*. However, *D. virgata* possesses flowers with a purple splotch above the yellow target area of the reflexed standard and keel petals with the upper mid-margin fimbriate.

Dioclea vallensis, *D. virgata* var. *crenata*, and *D. apurensis* possess upper keel petal margins with a few shallow crenate or dentate teeth. *Dioclea apurensis* has the smallest bracteoles (ca. 3 × 3 mm) and flower pedicels (ca. 3 mm long). Other species in series *Virgatae* include: *D. burkartii* from Argentina, southern Brazil, and Paraguay; *D. fimbriata* along the lower Amazon; *D. macrantha* from northern Amazonia, from the Guianas; and *D. virgata* from Amazonia and the Guianas into eastern South America, Central America, and Mexico, and south along the Andes to Bolivia.

Zamora (2000) places the monotypic *Cymbosema roseum* Benth. into *Dioclea* [= *Dioclea rosea* (Benth.) N. Zamora]. Queiroz et al. (2003: 317) indicated that "[t]his proposition has low bootstrap support in the present study (0.17) and the relationship of *Cymbosema* was sensitive to the type of analysis performed, which suggests that more data are needed to resolve its taxonomic placement." Placement of *D. macrantha* next to *C. roseum* occurred in Maxwell and Taylor's treatment (2003). These species in series *Virgatae*, *D. macrantha* and *D. fimbriata*, have long, pink to reddish flowers, rather than violet to purple; the standards spreading, rather than reflexed; and may represent different floral pollination syndromes, possibly ornithophilous, while the rest of the series *Virgatae* and subgenera have been noted as melittophilous (Queiroz et al., 2003: 305, 317). Varela et al. (2004: 65, 66) showed the close molecular sequence relationship of *C. roseum* to *D. guianensis* and *D. virgata* as a sister taxon of subgenus *Dioclea*, within the *Dioclea* clade. *Cymbosema roseum* has a pubescent calyx, small ovate bracteoles, a free vexillary stamen, a ca. 6-ovulate ovary, oblong fruit that is somewhat falcate, without ribs or wings parallel to the upper suture, ca. 4.4–6 × 1.8–2.2 × 0.4–0.7 cm, with a downcurved beak, and two to five seeds (Maxwell, 1970, 1999; Kirkbride et al., 2003).

Paratypes. COLOMBIA. **Chocó:** Rió San Juan, *J. Cuatrecasas 21380* (F); Docordó, N mouth of Río San Juan, *A. Gentry, E. Zardini, M. Monsalve & J. D. Caicedo 53845* (JEF, MO). **Valle del Cauca:** Dept. del Valle, along Río Anchicayá, *J. Cuatrecasas 15257* (F, US); del Valle, Pacific coast, Río Yurumanguí, *J. Cuatrecasas 15948* (F, US);

Cordoba, wooded cliffs of Río Dagua, *E. Killip 5065* (GH, NY, US); Dagua Valley, *E. Killip 5266* (NY, US).

II. Dioclea subg. **Platylobium** (Benth.) R. H. Maxwell, comb. et stat. nov. Basionym: *Dioclea* sect. *Platylobium* Benth., Fl. Bras. [Martius] 15(1): 164. 1859. TYPE: *Dioclea bicolor* Benth., Comm. Legum. Gen. 69. 1837.

Lianas, woody vines, shrubs, and small vines of open areas; stipules small, to ca. 5 mm or not produced; floral bracts mostly small, to ca. 10 mm. Flowers with upper calyx lobe entire to emarginate; standard lamina apex entire to emarginate, bicallose to ecallose; stamens 10, anthers 5 perfect + 5 imperfect dimorphic, 5 perfect + 5 slightly smaller dimorphic, rarely 10 uniform (section *Macrocarpon*). Fruit dry, hard or coriaceous, elastic or weakly dehiscent, mostly flat, 2–5 mm thick (except *Dioclea macrocarpa* forms), upper suture with close parallel, shallow ribs to either side, lower margin flanged; 1- to 5-seeded; seeds flat, soft, rarely overgrown, 13–30 × 10–20 × 2–5 mm (unless overgrown), hilum elliptic or short-oblong, encircling < 1/6 the circumference of the seed (except linear in *D. huberi* to ca. 2 cm, encircling ca. 1/4–1/2 the circumference of the seed).

IIa. Dioclea sect. **Platylobium** Benth., Fl. Bras. [Martius] 15(1): 164. 1859.

Stout, high-climbing forest lianas, facultative vines of semi-wooded habitats, shrubs and small vines of open areas. Leaflets with primary lateral veins in 6 to 14 pairs; stipules not produced below insertion, usually minute, persistent or caducous; brachyblasts subsessile, clavate with stalks to 10 mm; floral bracts mostly small, lanceolate, 3–10 mm; bracteoles minute, ovate-cordate to flabellate. Flowers with the upper lobe of the calyx entire to slightly emarginate; standard lamina apex entire to emarginate, bicallose to ecallose, lower margin weakly biauriculate; wings obliquely oblong to obovate, without spurs; keel petals obliquely oblong, semi-lunar or semi-orbicular, the apices rostrate, obtuse, or narrowly truncate, upper margin entire, without a prominent lobe; stamens 10, vexillary anther and inner alternate anthers of the staminal sheath smaller, dimorphic to the rest, or rarely 10 uniform; style occasionally swollen or flat distally, stigma capitate. Legumes dry, hard or coriaceous, elastic or weakly dehiscent, ca. 2–5 mm thick, pubescent to glabrate, upper suture with close parallel, shallow ribs to either side, lower margin flanged, 1- to 5-seeded; seeds usually flat, somewhat orbicular, dark, soft, 13–30 × 10–20 × 2–5 mm, hilum elliptic or short-oblong, encircling < 1/6 the circumference of the seed.

1. Dioclea hispidimarginata R. H. Maxwell, sp. nov. TYPE: Peru. Amazonas: Valle de Río Santiago, Caterpiza, 200 m, 27 Dec. 1979, *V. Huashikat 1654* (holotype, MO; isotype, JEF). Figure 3.

Haec species *Diocleae huberi* Ducke similis, sed ab ea antheris dimorphis, vexillo apice pubescente, alis oblique oblongis auriculae ora hyalina et hilo oblongo differt.

Lianas, stems terete, twining, the older with raised circular lenticels, sparsely ferruginous pubescent. Leaves with leaflets papyraceous, obovate to suborbicular, 9–20 × 7–14 cm, adaxial lamina surface glabrous or glabrate, faintly reticulate, abaxial surface with appressed, short hairs, apices rounded with abrupt acuminate tips, tips ca. 1 cm, bases mostly rounded or somewhat truncate to slightly cordate, smaller leaflet bases cuneate, primary lateral veins in ca. 7 to 11(to 13) pairs; petioles (4–)10–20 cm, rachis 2–4 cm, canaliculate, both with sparsely appressed to strigose, ferruginous pubescence, becoming glabrate; stipules not produced below insertion, linear-lanceolate, ca. 4–7 mm; stipels not seen. Inflorescences axillary, single, slender-terete, 35–80 cm, unbranched, with ferruginous to nigrescent pubescence, becoming glabrate, florate 2/3–4/5 the length; brachyblasts clavate, subsessile or with short, ascending stalks, heads nigrescent, incurved, usually swollen; floral bracts linear-lanceolate, (3–)6–7 mm, semi-persistent, appressed ferruginous pubescent outside, glabrous inside; bracteoles ovate to flabellate, ca. 1.5 × 2 mm, persistent; pedicels 3–4 mm. Flowers 1.1–1.7 cm, buds with calyx lobes navicular or somewhat rounded; calyx tube dark outside, glabrate, villous inside, upper lobe strongly reflexed, obtuse, emarginate, ca. 6 × 3 mm, lateral lobes broadly acute, ca. 4 × 3 mm, lower lobe acute, ca. 5 × 3.5 mm; standard strongly reflexed, ovate or obovate, ca. 10 × 10–17 mm, claw ca. 4 mm, bicallose, apex ferruginous pubescent, with hairs 0.5–1 mm; wings obliquely oblong, ca. 8 × 5 mm, claw 5–6.5 mm, auricle with a prominent hyaline rim; keel petals obliquely oblong to somewhat U-shaped, to ca. 6 mm, rising distally 7–9 mm to an oblique, somewhat obtuse beak, or appearing truncate, claw ca. 5 mm, weakly auriculate; stamens 10, glabrous, pseudomonadelphous, anthers dimorphic, 5 + 5; pistil geniculate, ovary ca. 6 mm, subsessile, villous with white and ferruginous hairs, disc long-toothed, 2- to 4-ovulate; style rising distally ca. 7 mm, style proximally with a row of adaxial ferruginous hairs, ca. 1.5 mm, extending up the slightly flattened style,

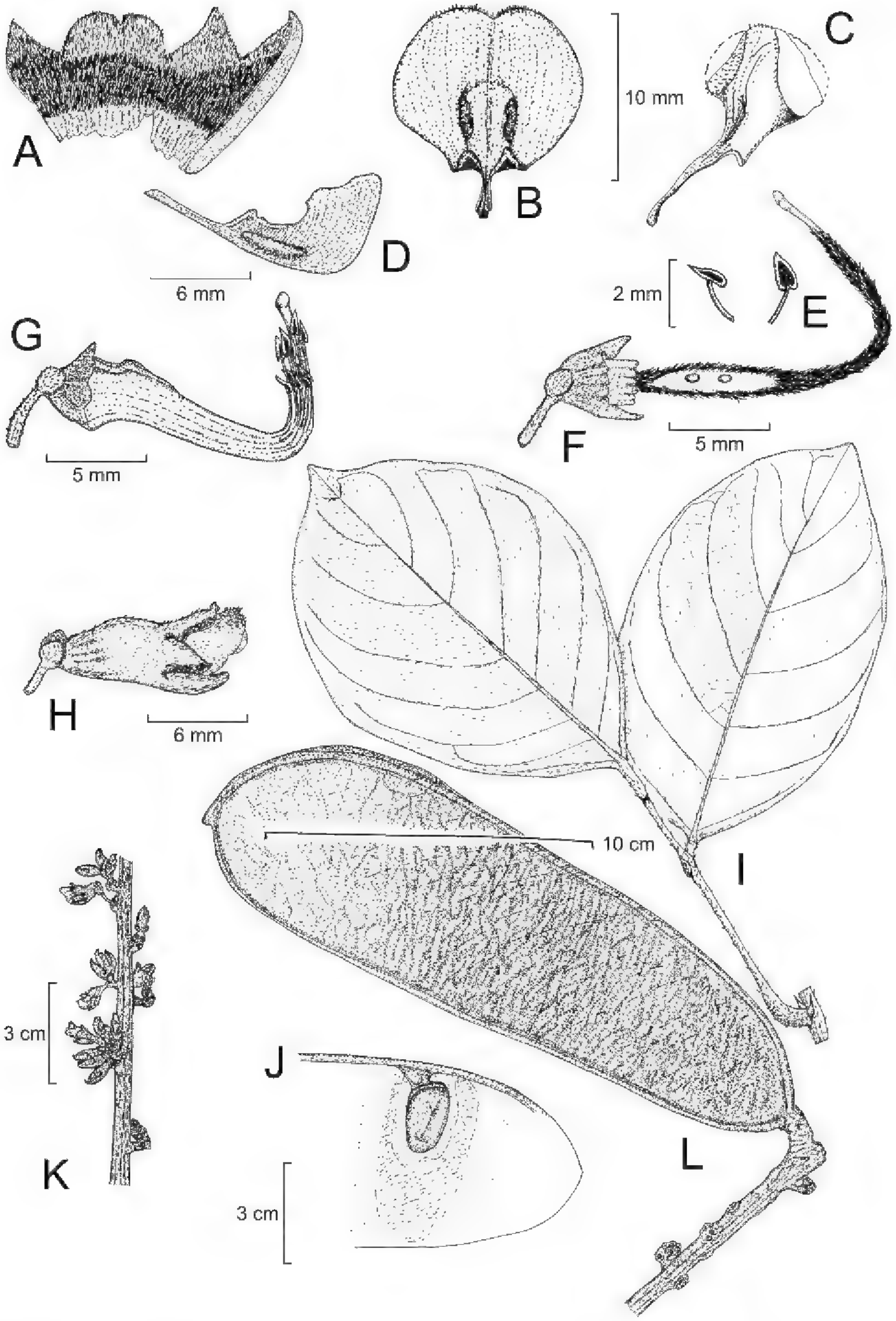

Figure 3. *Dioclea hispidimarginata* R. H. Maxwell. —A. Calyx, villous inner surface (6 mm scale). —B. Standard. —C. Wing petal. —D. Keel petal. —E. Dimorphic anthers. —F. Gynoecium, 2-ovulate, villous ovary with dentate disc below, with one bracteole attached to calyx remnant. —G. Androecium. —H. Flower bud. —I. Leaf showing terminal leaflet and one lateral leaflet, with one lateral leaflet missing. —J. Fruit outline, with developing seed. —K. Portion of inflorescence. —L. Fruit. A–H drawn from flower taken from the holotype *Huashikat 1654* (MO); K from *Tunqui 158* (MO); I, J, L from *Huashikat 1827* (MO).

distally glabrous ca. 3 mm, stigma capitate. Fruit oblong to somewhat obovate, flat, dry, mostly oblong or somewhat wider distally, to ca. 19 × 4 cm, ca. 6 cm wide distally, ca. 4 mm thick, weakly or tardily dehiscent, exocarp smooth (cracking?) with short, erect, ferruginous hairs, becoming glabrate, base rounded, apex rounded; upper margin culminating in a short, downcurved beak, the upper suture raised, with 2 close parallel ribs, lower margin appearing flanged, pedicel attachment median, 2- to 4-seeded; seeds immature, flat, probably soft, elliptic, the hilum oblong.

Distribution, habitat, phenology, and common name. Collections determined as *Dioclea hispidimarginata* have been found in Amazonas, Brazil; Amazonas and Loreto, Peru; and Putumayo, Colombia, at elevations from 100 to 200 m. Collectors report the flowers as violet (*Huashikat 1506*) or purple (*Tunqui 178*), flowering from November through January. The habitat has been reported as "monte virgem" (*Huashikat 1400*; *Tunqui 158*, *178*, *377*). Critical collections were made during the University of California Ethnobiological Expedition of 1979–1980. The common tribal name has been noted as "wapu naek" (*Huashikat 1506*, *1654*; *Tunqui 158*, *178*, *377*).

Discussion. *Dioclea hispidimarginata* possesses long inflorescences with numerous dark flower buds on somewhat fleshy globose brachyblast heads. The new species is named for the apical marginal pubescence on the standard, an unusual character in *Dioclea* sect. *Platylobium*. *Dioclea hispidimarginata* differs from *D. huberi* (in section *Macrocarpon*) in possessing dimorphic anthers, in a 5 + 5 arrangement, rather than 10 uniformly presented anthers; seeds with the hilum oblong rather than linear, to ca. 2 cm; the standard pubescent, rather than glabrous; and the corolla wings obliquely oblong, the auricle with a hyaline rim rather than somewhat dwarf wing petals with thickened auricles. Based on additional collections from Brazil, Bentham (1859) moved his species *D. bicolor*, *D. rostrata* Benth., and *D. glabra* Benth. from *Dioclea* sect. *Pachylobium* (sensu 1837) to section *Platylobium*. Bentham's section *Platylobium* was characterized by stipules not extending below insertion, imperfect alternate anthers, few ovules, fruit wider and distally containing two or three seeds, and the seeds with the hilum short and oblong.

Dioclea hispidimarginata shares sectional characteristics with *D. bicolor* from central Brazil; *D. coriacea* Benth., from the Planalto, central Brazil; *D. ferruginea* Ducke from Pará, Brazil; and *D. scabra* (Rich.) R. H. Maxwell from the Guianas, the Orinoco River region of Venezuela, and northern Brazil.

Paratypes. PERU. **Amazonas:** Río Santiago, vic. Caterpiza, 24 Nov. 1979, *V. Huashikat 1400* (JEF, MO); 65 km N of Pinglo, 17 Jan. 1980, *V. Huashikat 1827* (MO); Río Santiago, vic. Caterpiza, 28 Nov. 1979, *S. Tunqui 158* (MO), 29 Nov. 1979, *S. Tunqui 178* (JEF, MO), 20 Dec. 1979, *S. Tunqui 377* (MO).

IIb. Dioclea sect. **Macrocarpon** Amshoff, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 52: 69. 1939. TYPE: *Dioclea macrocarpa* Huber, Bol. Mus. Paraense Hist. Nat. Ethngr. 5(2): 410–411. 1909 (lectotype, designated here).

Discussion. Although *Dioclea macrocarpa* and *D. huberi* have uniform anthers, several ovules, and somewhat similar wings as Bentham's section *Eudioclea*, the shape of the keel petals, the upper keel margin configurations, and pods are distinct from the three sections described by Bentham (Amshoff, 1939: 69). Since 1939, *D. paniculata* Killip ex R. H. Maxwell (Maxwell, 1978), *D. steyermarkii* R. H. Maxwell (Maxwell, 1990b), and *D. ruddiae* R. H. Maxwell (Maxwell, 1988) have been tentatively assigned to section *Macrocarpon*. This section serves as a repository for *Dioclea* species with characters that do not fit comfortably into one of Bentham's three sections.

III. Dioclea subg. **Pachylobium** (Benth.) R. H. Maxwell, comb. et stat. nov. Basionym: *Dioclea* sect. *Pachylobium* Benth., Comm. Legum. Gen. 2: 68. 1837. TYPE: *Dioclea glabra* Benth. (lectotype, designated by Maxwell [1990a: 581]).

Mostly forest lianas, occasionally large coarse vines in open habitats climbing over smaller vegetation; leaflets with primary lateral veins in 8 to 12(to 18) pairs; stipules produced below insertion, large, to 3 cm (total length), rarely not produced or absent; floral bracts lanceolate, 6–14 mm, mostly caducous; bracteoles flabellate or ovate, small, 1–3(–5) mm (except oblanceolate, 5–8 mm in *Dioclea mollicoma* Ducke). Flowers with somewhat carnose petals, glabrous; calyx with upper lobe emarginate; standard reflexed, apex emarginate, bicallose, biauriculate basally with small flaps folded upward and usually not extending down the claw; wings mostly obliquely oblong, frequently unequal, rarely with a spur; keel petals triangular, semi-orbicular, or semilunar, rising distally into a slender or obtuse beak, or the distal raised portion truncate, the upper margin entire, occasionally with a median lobe or sinuate; stamens mostly pseudomonadelphous, occasionally

the vexillary very lightly joined or rarely free, the free basal vexillary filament occasionally pubescent, anthers 10, dimorphic, 5 perfect + 5 imperfect dimorphic, or 6 perfect + 4 imperfect dimorphic, rarely 10 perfect uniform; pistils with the style usually proximally swollen, ovary disc dentate. Fruit various, flat, compressed or turgid, dehiscent, tardily dehiscent, or indehiscent, coriaceous, hard or soft-fleshy; upper margins various, upper suture raised with a rib or wing close to each side, without extra wings or ribs, margin flanged, sulcate, or indistinct; lower margin occasionally sulcate, mostly flanged, or indistinct, (1 to)2- to 9(to 11)-seeded; seeds various, if hard, compressed, oval, or suborbicular, smooth, to 20 mm thick, occasionally showing flat planes of contact, 6–20 mm thick; if soft-overgrown, to 40 mm thick, somewhat cuboidal-, barrel-, or cone-shaped, ca. 3.5 × 3.2 × 1.8 cm; hilum linear, 3.5–4 cm, encircling nearly 1/2–4/5 the circumference of the seed (some fruit are unknown).

IIIa. Dioclea sect. **Pachylobium** Benth., Comm. Legum. Gen. 2: 68. 1837. TYPE: *Dioclea glabra* Benth. (lectotype, designated by Maxwell [1990a: 581]).

Floral bracts 6–9 mm; keel petal upper margins usually with a median lobe. Fruit various; oblong, compressed, mostly hard, 4- to 10-seeded; seeds various, mostly hard, oval, frequently showing flat planes of contact, cottony or feltlike tissue frequently adhering to the seed, hilum oval or encircling ca. 1/2 the circumference of the seed; or fruit thick-lobed, cylindrical, fleshy, 1- to 5-seeded; seeds soft, overgrown; hilum linear, encircling ca. 1/2 the circumference of the seed.

1. **Dioclea apiculata** R. H. Maxwell, sp. nov. TYPE: Bolivia. La Paz: N Yungas, near Coroico, E of Lake Titicaca, 1100 m, Oct.–Nov. 1912, *O. Buchtien 664* (holotype, MO; isotypes, F, G). Figure 4.

Haec species a congeneris *Diocleae* Kunth subg. *Pachylobii* (Benth.) R. H. Maxwell sect. *Pachylobii* Benth. stipulis lanceolatis usque ad 16 mm supra insertionem et fere 8 mm infra insertionem productis, foliolorum apice abrupte acuminato ca. 10 mm longo ac venis lateralibus primariis 10- ad 14-jugatis, alabastro apiculato, calycis lobo inferiore ceteros excedente, fructu trichomatibus velutinis ferrugineis vestito et seminibus (2 ad)5 vel 6(ad 8) cuneiformibus in substantia alba adhaerente inclusis hilo fere dimidium seminis circumferentiae cingente distinguitur.

Vines, high climbing, stems terete, pilose. Leaves with leaflets ovate-elliptic to broadly lanceolate, terminal leaflets to ca. 20 × 11 cm, lateral leaflets similar, adaxial lamina surface glabrous except the midrib, abaxial surface tomentose, apices abruptly acuminate, the tip to ca. 10 mm, terminal leaflet bases usually round to truncate, lateral leaflet bases round to slightly oblique; primary lateral veins in 10 to 14 pairs; petioles ca. 8–14 cm, rachis ca. 1/4 the petiole length; stipules lanceolate, persistent, to 16 mm distally, to 8 mm proximally, villose outside, glabrous inside; stipels acicular, to ca. 9 mm, ciliate. Inflorescences axillary or terminal, probably single and unbranched, to ca. 45 cm, florate length variable, < 1/2 to ca. the entire length, with fuscous pubescence; brachyblasts subsessile; floral bracts lanceolate, 7–9 × ca. 2 mm, ciliate outside, glabrous inside; bracteoles broadly ovate, ca. 3 × 2 mm, ferruginous, velutinous outside, glabrous inside, somewhat persistent; bractlets narrowly rhombic, to ca. 3 × 1.5 mm, ciliate outside; pedicels to ca. 10 mm. Flowers ca. 2.2 cm, buds with apiculate tips; calyx tube ca. 8 mm, ferruginous velutinous outside, fuscous velutinous inside, upper lobe emarginate, 7–9 × ca. 9 mm (width at base), lateral lobes falcate, ca. 7 × 4 mm, ciliate, lower lobe upcurved, ca. 10 × 5 mm; standard broadly orbicular, emarginate, ca. 18 × 19 mm, claw ca. 4 mm; wings somewhat square to obliquely oblong, equal, with the distal lower margin broadly crenulate, 13–15 × ca. 10 mm, claw ca. 7 mm; keel petals triangulate, auriculate, ca. 15 mm, rising distally ca. 12 mm culminating in a narrow beak, upper margin with a prominent median lobe, claw ca. 7 mm; stamens 10, vexillary filament short with imperfect anther, 5 perfect anthers on ca. 6 mm filaments, 4 imperfect anthers on ca. 1 mm filaments alternating with the perfect anthers; pistil with the ovary slightly downcurved then geniculate, rising ca. 10 mm, style glabrous distally ca. 6 mm; ovary ca. 7 mm, substipitate, villous with white hairs to 3 mm, disc dentate, ca. 6-ovulate; stigma terminal, capitate. Fruit dry, compressed, oblong to oblong-elliptic, to ca. 10 × 2.5 × 1.3 cm, indehiscent?, with ferruginous velutinous, stinging or nonstinging hairs, upper suture with parallel ribs, downcurved beak, lower suture becoming sulcate, (2 to)5- or 6(to 8)-seeded; seeds ovate to wedge-shaped, ca. 19 × 11 × 6 mm, enclosed in adherent white feltlike tissue, hilum linear, ca. 11–18 mm, encircling ca. 1/2 the circumference of the seed.

Distribution, habitat, and phenology. Dioclea apiculata has been found in Bolivia and collections have been determined for this species from Peru. This new species has been found in mountain forests at altitudes from 1100 to 2440 m on the eastern slopes of the Andes and observed to flower from October through February.

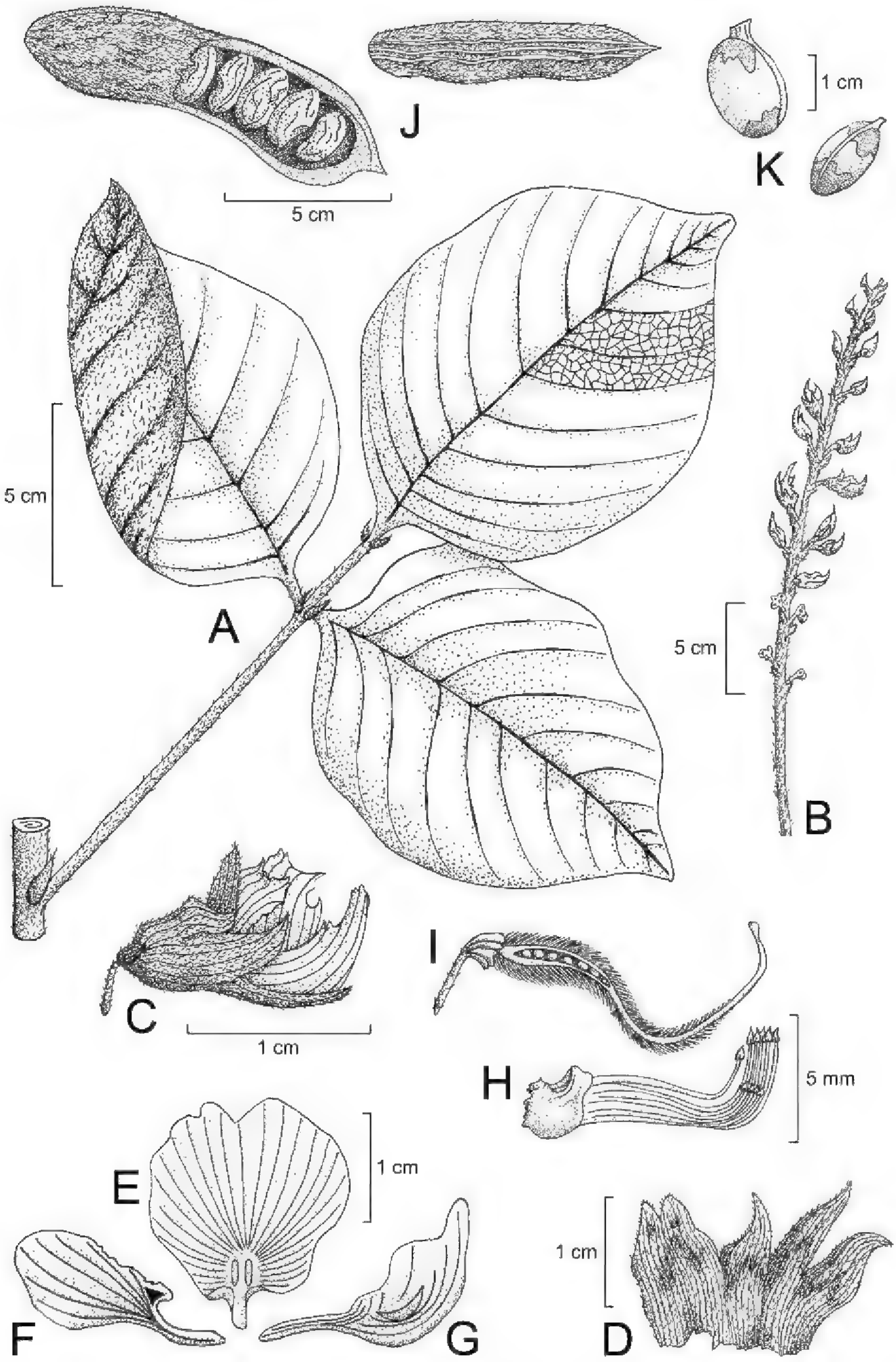

Figure 4. *Dioclea apiculata* R. H. Maxwell. —A. Leaf. —B. Portion of inflorescence. —C. Flower bud. —D. Calyx, inner surface. —E. Standard. —F. Wing petal. —G. Keel petal. —H. Androecium. —I. Gynoecium. —J. Fruit, dissected side view (at left) and upper suture view (at right). —K. Seeds showing hilum encircling nearly half the seed circumference. A–I drawn from the holotype *O. Buchtien 664* (F); J, K from the paratype *J. C. Solomon 9210* (MO).

Discussion. Flower color is reported from collectors as pale blue (*Solomon 9210*, MO), white-lilac (*Beck & Foster 13955*, NY), purple above and white below (*Besse et al. 1793*, MO), and purple (*Lewis 37925*, MO). The lower lobe of the calyx in flower buds protrudes upward, forming an apiculate tip. The fruits of *Solomon 9210* (MO) are covered with dark brown, stinging hairs. The immature fruit of *Besse et al. 1793* (MO) shows a similar shape and pubescence as those of *Solomon 9210* (MO), but the collector does not report stinging hairs. In *Dioclea* subg. *Pachylobium*, a variety of fruit and seeds exist. In *D. apiculata*, *D. sclerocarpa* Ducke, and *D. glabra*, seeds develop from soft to hard, but seed crowding early in pod development usually results in flat planes on the final hard seed nesting in thin or feltlike packing tissue. Species with somewhat similar seeds but larger fruit known to lack stinging hairs include *D. glabra*, from eastern and northeastern Brazil; *D. grandiflora* Mart. ex Benth., from caatinga in northeastern Brazil; and *D. sclerocarpa*, from northeastern Brazil.

Paratypes. BOLIVIA. **La Paz:** Murillo, Cahua, mtn. forest, mostly evergreen, 30 Oct. 1988, *S. G. Beck & R. Foster 13955* (NY); along Yalisa, 5 Nov. 1990, *M. Lewis 37925* (JEF, MO); Murillo, mostly montane evergreen forest, Unduavi, 1885, *H. Rusby 2397* (NY); Murillo, below dam at Lago Zongo, 19 Dec. 1982, *J. Solomon 9210* (MO); Nor Yungas, near Charocamba, 13 Feb. 1956, *E. de la Sota 632* (SI).

2. Dioclea circinata R. H. Maxwell, sp. nov. TYPE: Colombia. Meta: Camp 1, El Mico Airstrip, dense, humid forest, 450 m, 13 Nov. 1949, *W. R. Philipson, J. M. Idrobo & A. Fernandez 1405* (holotype, COL; isotypes, BM, S, US). Figure 5.

Haec species *Diocleae megacarpae* Rolfe similis, sed ab ea bracteis usque ad 7 mm tantum longis, carinae petalis longirostribus atque stylo gracili distinguitur.

Large lianas, woody climbers, stems terete, with appressed pubescence. Leaves with leaflets coriaceous, broadly ovate, terminal leaflet to ca. 18 × 11 cm, lateral leaflets to 11–16 × 7.5–11 cm, adaxial lamina surface slightly to distinctly rugose, glabrous, abaxial surface reticulate, strigose, along from the veinlets, apices obtuse or apiculate, bases rounded to slightly oblique, primary lateral veins in 9 to 13 pairs; petioles and rachis canaliculate, petioles 8.4–15.2 cm, rachis 2–5 cm, with fulvous appressed pubescence; stipules lanceolate, produced to ca. 5 mm distally, < 5 mm proximally; stipels setiform, ca. 3 mm, pubescent. Inflorescences axillary, solitary at axis, with a coiling tendency, 30–45 cm, florate almost to the base; brachyblasts clavate, short-stalked, heads incurved; floral bracts linear-lanceolate, to ca. 7 mm, appressed pubescent and ciliate outside, puberulent inside, caducous; bracteoles broadly flabellate, ca. 2 × 2.5–4 mm, caducous; bractlets similar to the bracteoles; pedicels ca. 5 mm. Flowers ca. 25 mm, buds with calyx lobes upcurved; calyx sparsely pubescent, tube ca. 10 mm, upper lobe broadly oblong, apex truncate, or slightly emarginate, ca. 8 × 10 mm, lateral lobes lanceolate-falcate, 7–10 × 4–5 mm, lower lobe lanceolate, to 11–13 × ca. 6 mm; standard broadly ovate, ca. 20 × 16–24 mm, bicallose, claw ca. 4 mm; wings free from the keel petals, lower lamina interlocked with each other under the keel petals in the bud, triangular to obliquely oblong, 16–23 × 9–13 mm, claw ca. 6 mm; keel petals triangular to semi-lunar, ca. 13 mm, rising distally ca. 12 mm to a narrow beak, weakly auriculate basally, upper margin with a prominent median lobe, claw ca. 5.5 mm; stamens 10, pseudomonadelphous, vexillary filament free basally ca. 3 mm, pubescent; anthers dimorphic, 5 perfect + 5 imperfect; pistil straight 17–20 mm, rising distally ca. 13 mm, style glabrous distally ca. 6 mm; ovary ca. 6 mm, short-stipitate, with rigid white hairs ca. 2.5 mm, disc dentate, ca. 5-ovulate; stigma terminal, capitate. Fruit unknown.

Distribution, habitat, phenology, and etymology. The holotype and paratype collections of *Dioclea circinata* are from Meta, Colombia. Both are from dense humid forests in the Serranía de La Macarena region, at 450–500 m in altitude. Both collection labels note the flowers as lilac, with flowering from November through January. The species epithet, *circinata*, refers to the coiling tendency of the inflorescences as they develop.

Discussion. The collectors of the holotype (*W. R. Philipson et al. 1405*, COL) note the sap as drinkable. The collectors of the paratype (*Philipson & Idrobo 1996*, BM, COL, US) note a red stain under the bark and note the common name of "bejuco de agua." Both type collections were originally determined as *Dioclea megacarpa* Rolfe, but the collections differ from that species by the keel petals with slender beaks (vs. truncate in *D. megacarpa*), floral bracts to ca. 7 mm long (vs. to ca. 20 mm). Maxwell (1969: 165) described this taxon as a new variety under *D. malacocarpa* Ducke, expecting the fruit, when found, to be turgid with overgrown seeds (Corner, 1951: 141; Kirkbride et al., 2003: 18). However, because of the many different types of fruit in *Dioclea*, fruit, when found, could also be similar to that of *D. apiculata*, which would place the new species in that species

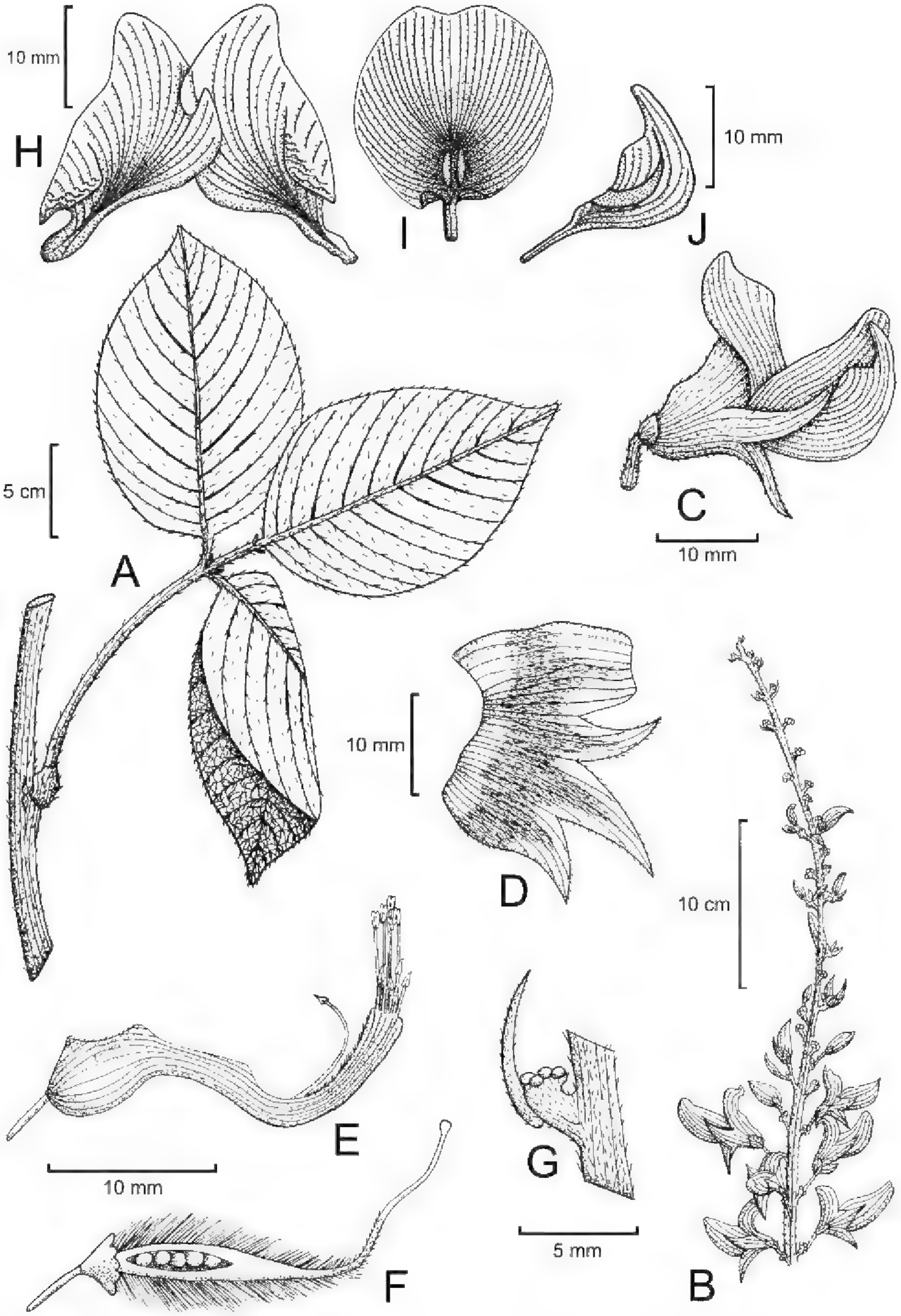

Figure 5. *Dioclea circinata* R. H. Maxwell. —A. Leaf. —B. Portion of inflorescence. —C. Flower. —D. Calyx, inner surface. —E. Androecium. —F. Gynoecium. —G. Portion of inflorescence, brachyblast with floral bract. —H. Interlocked wing petals. —I. Standard. —J. Keel petal. A drawn from *Philipson & Idrobo 1996* (BM); B–J from the type *Philipson, Idrobo & Fernandez 1405* (BM, COL, S).

group with somewhat similar fruit. If the fruit is turgid with soft, overgrown seeds, placement would be with similar species in *Dioclea* subg. *Pachylobium*, such as *D. malacocarpa* and *D. haughtii* (Fig. 6).

Paratype. COLOMBIA. **Meta:** Sierra de La Macarena, Caño Entrada, 29 Dec. 1949, *W. R. Philipson & J. M. Idrobo 1996* (BM, COL, US).

3. Dioclea haughtii R. H. Maxwell, sp. nov. TYPE: Colombia. Meta: Los Llanos, Río Humea, at Puerto Sanchez, 7 Feb. 1939, *O. Haught 2583* (holotype, COL; isotypes, GH, RB p.p. [excl. seeds], S, US, VEN). Figure 6.

Haec species *Diocleae malacocarpae* Ducke fructu turgido et seminibus magnis mollibusque similis, sed ab ea carinae rostro cucullato atque fructus trichomatibus urentibus differt.

Lianas, stems terete, substrigose. Leaves with leaflets ovate to ovate-elliptic, terminal leaflets ca. 12 × 8 cm, lateral leaflets ca. 12 × 7.5 cm, adaxial lamina surface glabrescent, except the midrib pubescent, somewhat rugose, abaxial surface densely sericeous, apices abruptly acute, terminal leaflet bases truncate or round, lateral leaflet bases oblique, primary lateral veins in 9 to 12 pairs; petioles 11–14 cm, rachis ca. 1.5 cm, both densely substrigose; stipules produced below insertion, ca. 1.5 cm, persistent; stipels subulate, ca. 4 mm, persistent. Inflorescences axillary, single, unbranched, to 40 cm, pubescent; brachyblasts clavate, with a stalk ca. 1 mm; floral bracts unknown; bracteoles slightly flabellate, ca. 1.5 × 2 mm, persistent, ferruginous pubescent outside, glabrous inside; pedicels ca. 6 mm. Flowers ca. 1.5 cm, flower buds straight, slightly globose; calyx tube ca. 6.5 mm, fuscous pubescent outside, irregularly velutinous inside, striations evident, calyx lobes blunt, upper lobe emarginate, obtuse, ca. 4 × 4 mm basally, lateral lobes acute, slightly falcate, ca. 4 × 3 mm, lower lobe upcurved, broadly lanceolate, ca. 5 × 3.5 mm; standard obovate-orbicular, red-purple, ca. 11 × 10 mm, claw ca. 3 × 2 mm; wings obliquely oblong, to 7–10 × 4–6 mm, claw ca. 5 mm; keel petals semi-lunar, ca. 7 mm, rising distally ca. 9 mm, culminating in a hooded beak, upper margin basally rounded or weakly auriculate, with a prominent median lobe, claw ca. 4 mm; stamens 10, anthers 5 perfect + 5 imperfect, fertile anthers < 1 mm, vexillary filament free at the base ca. 2 mm, pubescent; pistil somewhat straight ca. 10–12 mm, then geniculate ca. 7–9 mm, style proximally slightly thickened, sparsely ciliate, style distally bent back, glabrous ca. 2 mm; ovary ca. 5 mm, villous with canescent or fuscous hairs 1.5–2 mm, ca. 2- to 4(to 5)-ovulate, disc dentate. Fruit [known only from the paratype, *Davidse & González 16,219* (MO)] turgid, oblong, straight, 9.5–15 × 4.5–5 × 4–5 cm, presumed indehiscent, wrinkled with detached stinging hairs, upper and lower sutures indistinct, lacking ribs or wings, 2- to 4(to 5)-seeded; seeds soft, overgrown, cuboidal, cone-shaped or barrel-shaped, showing flat planes of contact, ca. 4.5 × 2.4–4 × 4 cm, the hilum linear-oblong, ca. 7 cm, encircling ca. 1/2 the circumference of the seed.

Distribution, habitat, and etymology. The holotype collection (*Haught 2583*, COL) noted the specimen as a rather slender liana with showy, inodorous reddish purple flowers collected in the forest along the Río Humea at Puerto Sanchez, in Meta, Colombia. The species is named after Oscar Haught, a knowledgeable collector of the Ecuadorian and Peruvian flora.

Discussion. The paratype collection *Davidse & González 16,219* (JEF, MO) noted that the specimen was a large liana in a deciduous gallery forest, ca. 19 airline km SW of Elorza, Apure, Venezuela. Also noted was the "[l]arge liana; fruit green covered with irritating brown hairs; seeds used to make flour for arepas,. . .common name 'chocha.'" The RB isotype is, I believe, a mixture; the seeds do not belong. Because of the many types of fruit among the large lianas of *Dioclea* s.l., there is always a risk in assigning fruit-only collections to flower-only collections, but the two type collections otherwise correspond. In the transition of fruit and seeds in *Dioclea* s.l., one type includes those species producing seeds that remain soft, swelling to fill the indehiscent, turgid pod, with an increase in the thickness of packing tissue around the seeds (Fig. 6J, K). These are overgrown fruit and some parts may be edible. Species within this subgenus group with such known overgrown seeds include *D. aurea* R. H. Maxwell from Panama and Colombia, *D. edulis* Kuhlm. from eastern Brazil, *D. malacocarpa* from central and northern South America, *D. pulchra* Moldenke from Colombia and extending into Central America, *D. rufescens* Benth. from eastern Brazil, and *D. ucayalina* Harms from Colombia, Ecuador, and Peru.

Paratype. VENEZUELA. **Apure:** Dist. Rómulo Gallegos, Caño Caribe, 90 m, 8 Mar. 1979, *G. Davidse & A. C. González 16,219* (JEF, MO).

4. Dioclea jamesonii R. H. Maxwell, sp. nov. TYPE: Ecuador. "Collectio Reichenbach fil., Acqu. 1889," *W. Jameson s.n.* (holotype, W 125398; isotype, W 125301). Figure 7.

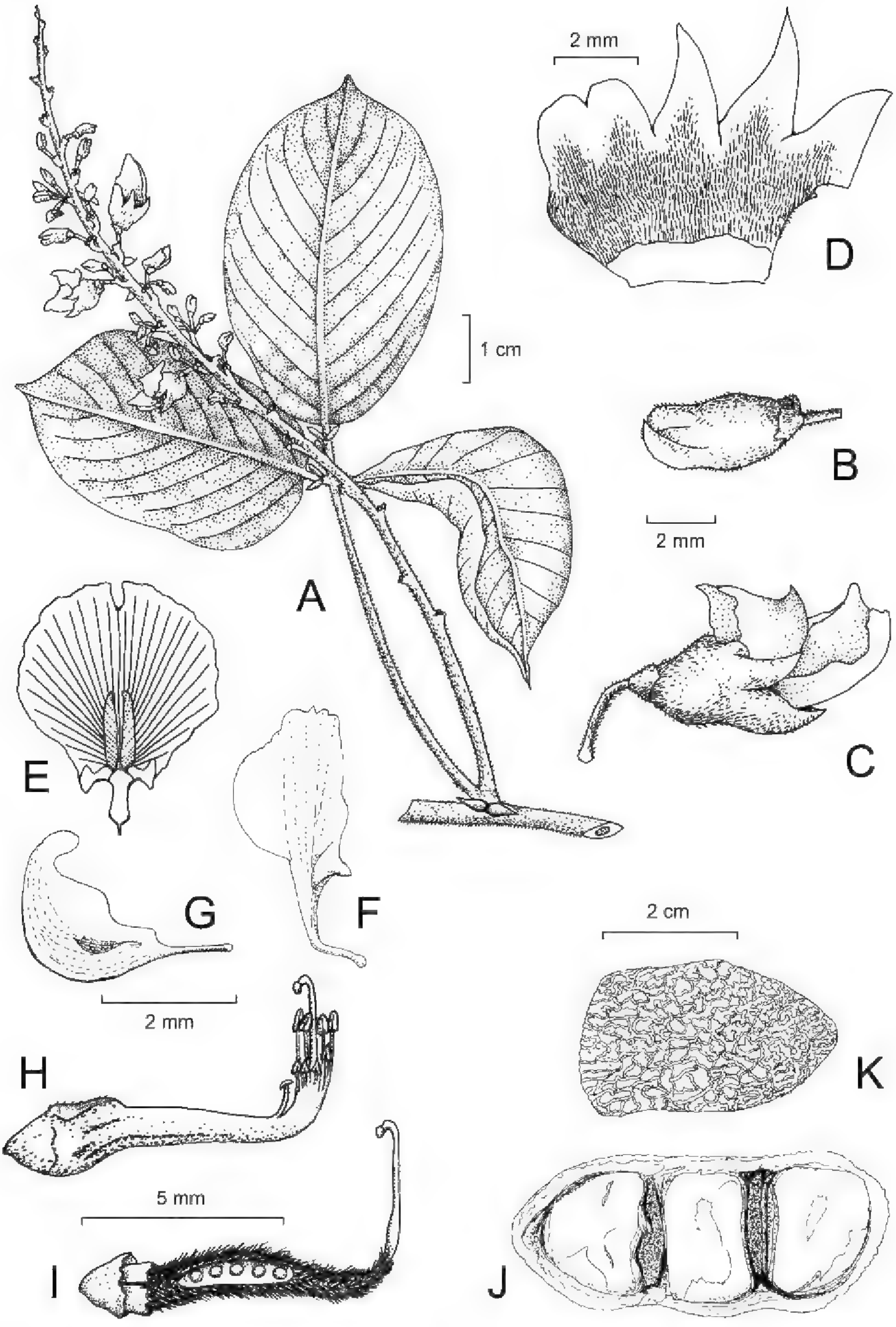

Figure 6. *Dioclea haughtii* R. H. Maxwell. —A. Habit with leaf, inflorescence, and piece of stem showing stipule produced below insertion. —B. Flower bud. —C. Flower. —D. Calyx, inner surface. —E. Standard. —F. Wing petal. —G. Keel petal. —H. Androecium. —I. Gynoecium, ovary with dentate disc. —J. Three-seeded fruit with overgrown seeds sliced in half. —K. Turgid fruit, wrinkled piece of exocarp. A–I drawn from the holotype *O. Haught 2583* (COL); J, K from the paratype *G. Davidse & González 16,219* (MO).

Haec species *Diocleae mollicomae* Ducke pubescentia argentea sericea in pagina inferiore laminarum foliolorum similis, sed ab ea foliolorum venis lateralibus primariis 9-jugatis, bracteolis late ovatis usque flabellatis ca. 3 × 3 mm, ovario 4- vel 5-ovulato et seminibus minoribus differt.

Lianas, stems terete, fulvous, pilose. Leaves with leaflets somewhat coriaceous, broadly ovate, ca. 13–15 × 8–10 cm, lateral leaflets slightly oblique, adaxial lamina surface dark, slightly rugose, glabrescent, except pubescent along the midrib, abaxial surface argenteous sericeous, apices obtuse or with an acumen ca. 5 mm, or abruptly acute, bases rounded to slightly cordate, primary lateral veins in ca. 9 pairs; petioles ca. 6–9 cm, rachis ca. 1.5–2.5 cm, tomentose; stipules lanceolate, 7–8(–10) mm distally, 3–5(–9) mm proximally, densely pubescent outside; stipels filamentous, ca. 4 mm. Inflorescences terminal, axillary, single, unbranched, ca. 39 cm, florate < 1/2–2/3 the length; brachyblasts subsessile; floral bracts broadly lanceolate, ca. 8 × 2 mm, pubescent on both sides; bracteoles broadly ovate to flabellate, ca. 3 × 3 mm, pale ferruginous outside, glabrous inside, persistent; bractlets ca. 2 × 1 mm; pedicels ca. 4 mm. Flowers ca. 1.6 cm, buds straight; calyx tube ca. 7 mm, ferruginous, upper lobe emarginate, obtuse, ca. 3.5 × 6.5 mm, lateral lobes acute, slightly falcate, ca. 4 × 3 mm, lower lobe lanceolate, ca. 5 × 3.5 mm [insect damaged]; standard [partially missing in the type] reflexed, broadly obovate, ca. 10 × 12 mm, apex emarginate, bicallose, biauriculate, claw ca. 3.5 mm; wings obliquely oblong to obovate, ca. 8 × 6 mm, auricle sharp, without a spur, claw ca. 4 mm; keel petals broadly falcate, ca. 5 mm, rising distally ca. 8 mm, beaked [truncate or insect damaged?], upper margin auriculate at the base, with a weak supra-median lobe or lacking a median lobe, claw ca. 4 mm; stamens 10, pseudomonadelphous, vexillary stamen free at the base ca. 3 mm, glabrous, anthers 5 perfect + 5 imperfect; pistil slightly downcurved ca. 11 mm, then upcurved ca. 7 mm, style bulbous, proximally villous, distally glabrous 2–5 mm, ovary ca. 5 mm, substipitate, with dense white hairs to 1 mm, disc condition unknown, 4- or 5-ovulate; stigma terminal, capitate. Fruit compressed, 3-seeded, oblong-elliptic, ca. 15 × 6 × 1.4 cm; 1-seeded, somewhat oval, ca. 8.5 × 6 × 1.4 cm; indehiscent or partially dehiscent at the lower margin; exocarp with sparse, appressed, ferruginous pubescence to glabrescent; upper suture indistinct, the margin flat, with edges extending into wings, lower fruit margin flanged, 1- to 5-seeded; seeds hard, oval, ca. 31 × 25 × 18 mm, dark brown with a piece of woody raphe persistent; hilum linear, ca. 6 cm, encircling ca. 3/4 the circumference of the seed.

Distribution and habitat. *Dioclea jamesonii* was found in Ecuador. The paratype collectors *Dodson & Thien 1200* (MO) noted the specimen as lianas collected at 350 m in northern Ecuador with the flowers blue and white. In contrast, the paratype collectors *Andre 4149* (K) noted the flowers as azure-lilac, from the central mountains at ca. 2200 m in southern Ecuador.

Discussion. The new species is named after William Jameson, who lived, collected, and taught in Ecuador from 1822 to 1869 (Jørgensen, 1999). *Dioclea jamesonii* shares the distinctive white pubescence on the abaxial leaflet surface with *D. mollicoma* Ducke, but has fewer primary lateral vein pairs (nine vs. 12 to 15 in *D. mollicoma*), bracteoles widely ovate to flabellate and ca. 3 × 3 mm (vs. oblanceolate and ca. 5–8 mm long), smaller seeds to 31 mm long (vs. to 42 mm long). Ovaries are 4- or 5-ovulate in *D. jamesonii* rather than 2-ovulate in *D. mollicoma* in those collections examined for both species. Other species with fruit and seeds similar to *D. jamesonii* (Fig. 71, J) include *D. densiflora* Huber from Brazil; *D. javanica* Benth. from Asia; *D. mollicoma* from Brazil, Peru, and ranging to the West Indies and Dominica; *D. umbrina* Elmer from the Philippines; *D. wilsonii* from the New World tropics; and *D. reflexa* from Africa and the Asian tropics.

Paratypes. ECUADOR. **Loja:** betw. Río Camba & Loja city, July 1876, *E. André 4196* (K); Los Ríos, Jauneche forest, fruits black, in swamp, 24 Jan. 1981 (fr.), *A. Gentry, C. Bonifaz, J. Loor & R. Lao 30736* (MO); Prov. Pichincha, vine along Río Baba, S of Santo Domingo, 3 Nov. 1961, *C. Dodson & L. Thien 1200* (MO).

Acknowledgments. Robert H. Mohlenbrock (SIU, Carbondale) contributed the original Latin descriptions for new sections and species (Maxwell, 1969). The Latin descriptions have been modified for publication in *Novon* by Mark A. Garland and Roy Gereau (MO). Inflorescence and floral details are from dissection sketches by the author. Preliminary pen-and-ink drawings were done by students in the Art Department of Southern Illinois University at Carbondale during 1970–1974 and enhanced by Kathryn Duffy. Illustrations of *Dioclea ovalis*, *D. vallensis*, *D. apiculata*, and *D. circinata* are by Kathryn Duffy. Illustrations of *D. hispidimarginata*, *D. haughtii*, and *D. jamesonii* are by Freda Burton (SIU), additions or modifications are by Duffy and/or the author. *Dioclea* was suggested as a revision project for the Ph.D. by John D. Dwyer (1915–2005) (St. Louis University and MO), when the author was a

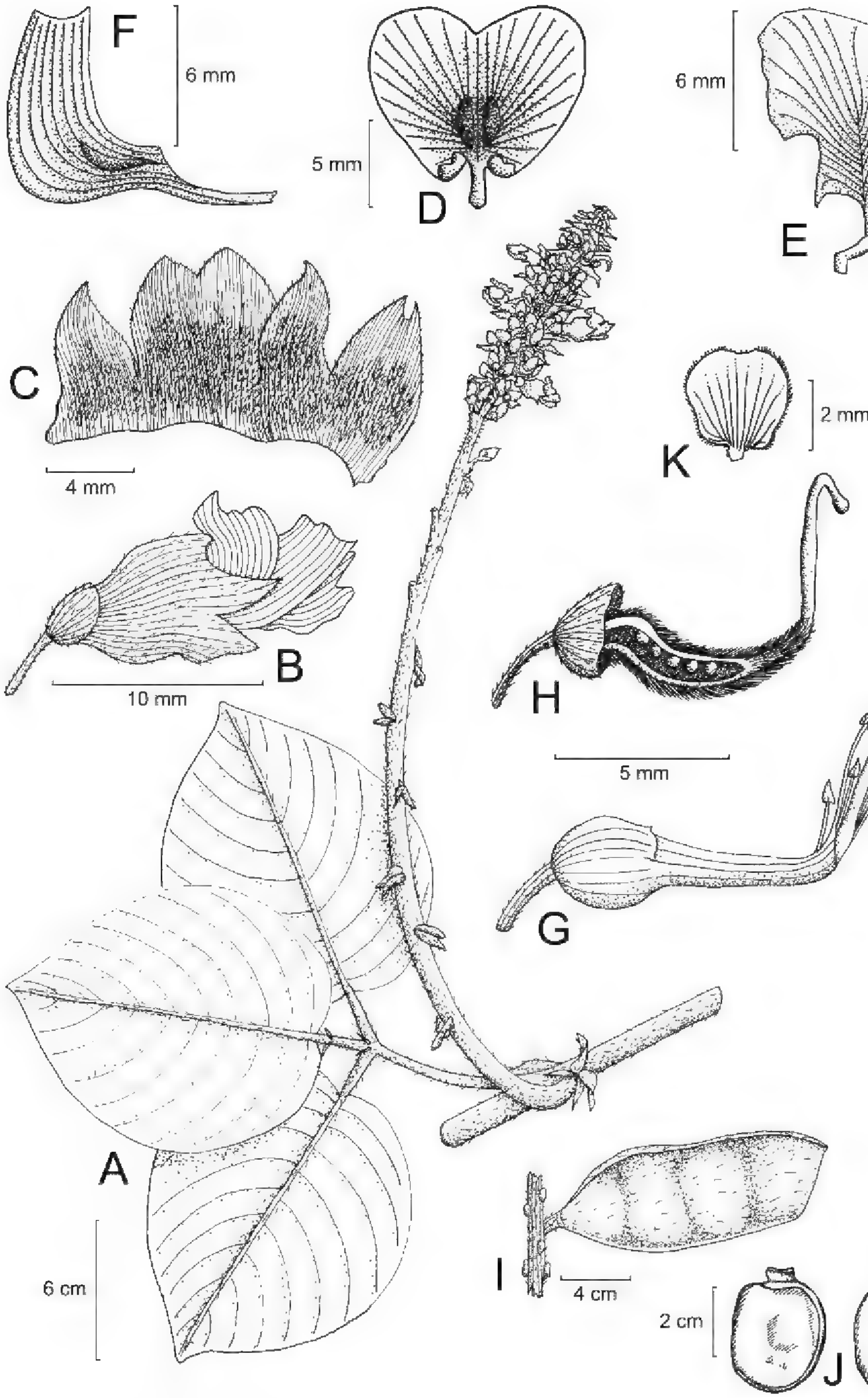

Figure 7. *Dioclea jamesonii* R. H. Maxwell. —A. Habit with leaf, inflorescence, and piece of stem, showing produced stipules. —B. Flower bud with bracteole. —C. Calyx, inner surface (lower lobe showing insect damage). —D. Standard. —E. Wing petal. —F. Keel petal (apex insect damaged). —G. Androecium. —H. Gynoecium. —I. Fruit. —J. Seeds, hilum view (at right) and side view (at left). —K. Bracteole, inner surface. A–C, E–H, K drawn from the type *Jameson s.n.* (W); D from the paratype *Dodson & Thien 1200* (MO); I, J from the paratype *Gentry et al. 30736* (MO).

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Cestrum sotonunezii, a New Species of Solanaceae from Central Mexico

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Abstract. The new species *Cestrum sotonunezii* Mont.-Castro (Solanaceae) is described from central Mexico. Because of their overall similarity, specimens of the new species have been previously confused with *C. flavescens* Greenm., *C. aurantiacum* Lindl., *C. oblongifolium* Schltdl., and *C. thyrsoideum* Kunth, all of which also occur in central Mexico. The new species is most similar to *C. flavescens*, but is clearly separated by several characteristics, mainly differences in the androecium. The new species is described and illustrated, and a key to distinguish morphologically similar species in central Mexico (Guerrero, Michoacán) is provided.

Resumen. Se describe la especie nueva *Cestrum sotonunezii* Mont.-Castro (Solanaceae) proveniente del centro de México. Las colecciones de la nueva especie han sido confundidas con otras especies que se distribuyen en el centro de México como *C. flavescens* Greenm., *C. aurantiacum* Lindl., *C. oblongifolium* Schltdl. y *C. thyrsoideum* Kunth. Con la primera especie guarda gran parecido pero *C. sotonunezii* está claramente separada por varias características, especialmente en los estambres. Se incluye ilustración de este taxon y clave para diferenciar especies morfológicamente similares del centro de México (Guerrero, Michoacán).

Key words: Balsas River Basin, *Cestrum*, *Cestrum* sect. *Habrothamnus*, Guerrero, IUCN Red List, Mexico, Michoacán, Solanaceae.

Flowers of *Cestrum* L. (Solanaceae) are readily identified as being tubular and narrow, with relatively short lobes, and frequently grouped into axillary clusters along or at the branch apices. In addition, the basal portion of the androecium is fused to the lower internal corolla wall, where a bulge is developed close to the point of adnation. A more detailed description of these and other contrasting features of *Cestrum* can be found in Benítez de Rojas and D'Arcy (1998). The new species *C. sotonunezii* Mont.-Castro, like other species in *Cestrum* sect. *Habrothamnus* (Endl.) Schltdl., has highly attractive, club-shaped flowers, which are visited by hummingbirds (D'Arcy, 1999). This floral shape has been a diagnostic feature to classify species in this section (Francey, 1935). However, this proposed classification has been questioned by Nee (2001), and work is now in progress in the systematics of *Cestrum* to ascertain the phylogeny of this group of plants (Montero et al., 2006).

Specimens of the new species *Cestrum sotonunezii* have been previously confused with those of *C. aurantiacum* Lindl., *C. oblongifolium* Schltdl., and *C. thyrsoideum* Kunth, even though these latter three species clearly differ morphologically from the former. Presumably, these misidentifications occurred because all four species have brilliant yellow, tubular corollas and are distributed mainly in central Mexico. Material of *C. sotonunezii* is more difficult to distinguish from that of *C. flavescens* Greenm. because both species have twigs, buds, and leaves with crumpled hairs, and flowers with comparable shape and color. Nonetheless, plants of *C. sotonunezii* can usually be distinguished by being more robust and by having the filaments emerging immediately below or directly from a bilobed bulge in the corolla, as well as by the length of its corolla lobes. The distinctions between these five species are presented in the following key. This key separates *C. sotonunezii* and allied species in central Mexico that are characterized by having 5- to 25-flowered axillary cymes near the branch tips, with unscented, showy, yellow or orange flowers.

Key to *Cestrum sotonunezii* and Allied Species in Central Mexico

1a. Calyx tube > 7 mm long ..... *C. thyrsoideum*
1b. Calyx tube < 6.5 mm long.
  2a. Plants flowering only when mature leaves are present; leaves glabrous.
    3a. Calyx lobes mucronate .... *C. aurantiacum*
    3b. Calyx lobes deltate ..... *C. oblongifolium*
  2b. Plants flowering when development of leaves begins or with mature leaves; leaves pubescent.
    4a. Stamen filament bases adnate to the lower internal corolla wall, free portion emerging ca. 2 mm above an entire bulge; corolla lobes ≤ 1 mm ..... *C. flavescens*
    4b. Stamen filament bases adnate to the lower internal corolla wall, free portion emerging below or directly from a bilobed bulge; corolla lobes 1.3 2.8 mm ..... *C. sotonunezii*

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Cestrum sotonunezii Mont.-Castro, sp. nov. TYPE: Mexico. Guerrero: Mpio. Chichihualco [Mpio. Leonardo Bravo], Filo de Caballo, 2190 m, 22 May 1986, *J. C. Soto Núñez 12678* (holotype, MEXU; isotypes, MO, NY, US). Figure 1.

Haec species inter congeneros centralimexicanos quoad folia pubescentia, florescentiam praecocem coaetaneumve etiam tubum calycinum minus quam 6.5 mm longum *Cestro flavescenti* Greenm. simillima, sed ab eo ramis robustioribus, foliis majoribus, lobis corollinis 1.3 2.8 mm longis atque staminibus ad corollae parietem internum infra protuberationem bilobam insertis vel ex ea ipsa ortis distinguitur.

Shrubs 1–3 m high, flowering from the end of dry season when leafless or as the new leaves develop, few-branched from the base, glabrous, sparsely covered with lenticels; twigs and buds pubescent with crisped hairs. Leaves simple, alternate, membranous, puberulent adaxially, tomentose abaxially, ovate to widely ovate (young leaves elliptic), 3.7–10 × 2–5.8 cm, cuneate at base, acuminate at apex, lateral veins 7 to 9, opposite to subopposite, arcuate-ascending; petiole canaliculate, 11–30 mm. Inflorescences in axillary cymes on young branches, several-flowered, each cyme comprising 3 to 4 sessile flowers, peduncle 4–8 mm, often several cymes grouped near branch tip forming a corymbiform structure. Flowers diurnal, unscented, 14–22 mm, subtended by a bract, trullate-lanceolate, pilosulose, 1.2–7 × 0.5–3 mm; calyx obconic, 4.5–6.5 × 2.2–2.7 mm, pilosulose, teeth deltoid, 0.5–1 mm, the tips ciliolate and faintly reflexed; corolla clavate, bright yellow-orange, tube 13–21 mm, glabrous, expanding gradually upward, contracted near the limb, mouth 2.9–3.5 mm wide, lobes deltoid, 1.3–2.4 × 1.8–2.9 mm, external margins ciliolate; stamens 10.5–19 mm, filament bases adnate to the corolla inner wall, free portion of filaments emerging below or directly from a bilobed bulge, up to 6–10 mm, glabrous; anthers oblong, 1.1–1.25 mm; gynoecium with nectary disk; ovary globose, 1–1.3 mm across, glabrous, 9 to 12 ovules; style 11–19 mm, distally granulose; stigma capitate, minutely papillate. Fruits ovoid, white, 6.5–9 × 5–7.5 mm; fruiting calyx accrescent, 7–9 mm, sometimes splitting at the sinuses; seeds prismatic in shape, 3.5–5 × 2.1–3 mm.

Distribution, habitat, and IUCN Red List category. The new species has been collected only in small areas at altitudes from 1800 to 2800 m on calcareous soils, in ecotone communities of oak woodlands and tropical dry forests in two regions of central Mexico, from localities near Mil Cumbres, Michoacán, along the Trans-Mexican Volcanic Belt, and from localities near Filo de Caballo, Guerrero, along the Sierra Madre del Sur. These areas of occupancy are separated by 260 km (air), but are principally isolated by the barrier of the Balsas River Basin. Although the areas of occupancy are very distant, they are smaller than 10 km^2, and moreover the population size is fewer than 250 mature individuals. Thus, according to IUCN Red List criteria (IUCN, 2001), this species is evaluated here as Endangered (EN). Because this species is distributed in an ecotone, it is difficult to specify the different climatic variables. The climate within the different localities was established with the help of climatic maps (Vidal-Zepeda, 1990; García & CONABIO, 1998). *Cestrum sotonunezii* is distributed in an intermediate climate, ranging from temperate subhumid to semiwarm subhumid, group C types, with an annual mean temperature between 12°C and less than 18°C, and an annual mean precipitation of 800 to 1200 mm. The microclimatic conditions of the localities will be evaluated in further detailed studies.

Etymology. The specific epithet honors Jóse C. Soto Núñez, an important collector in the region where this species is distributed, who has contributed to the knowledge of the diversity of the flora of Mexico.

Discussion. *Cestrum sotonunezii* is clearly distinguishable from *C. thyrsoideum*, since the former has a tight calyx at the base of the corolla, and the calyx length is less than one third of the corolla length. In contrast, the calyx of *C. thyrsoideum* is loosely placed on the corolla base, and its length exceeds one third of the corolla length. *Cestrum oblongifolium* and *C. aurantiacum* can both be distinguished from the new species by their glabrous leaves. More complex is the differentiation of *C. sotonunezii* from *C. flavescens*, as both species are superficially similar in both vegetation and flowers. Furthermore, both species flower from February to May when the plants are completely or nearly leafless. However, specimens of *C. sotonunezii* have more robust branches than *C. flavescens*, and while the leaves of the two species have comparable pubescence, those of *C. flavescens* are consistently smaller. In addition, flowers of both are similar in size, often slightly bigger in *C. flavescens* (although a populational study is needed to confirm this). The features that definitely separate these two species are the stamen and the degree of fusion between the internal corolla and the filaments. In *C. flavescens*, the stamens extend to ca. 2 mm below the stigma, and their bases are fused to the corolla ca. 2 mm above the bulge of the filaments (Fig. 2). Conversely, in *C. sotonunezii* the stamens reach to 1 mm below the stigma, and their bases are fused to the corolla below or at the same height as the corolla bulges.

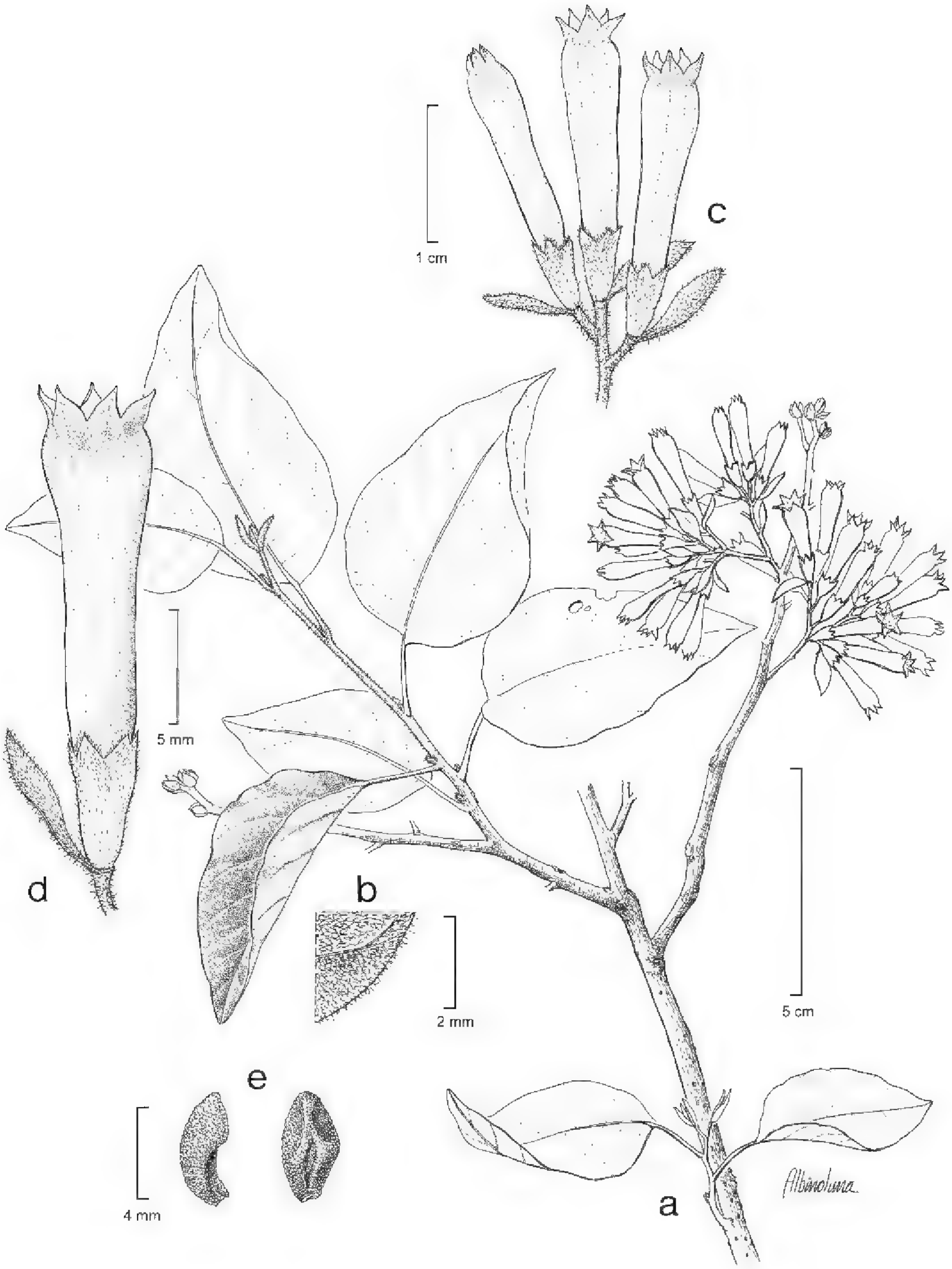

Figure 1. *Cestrum sotonunezii* Mont.-Castro. —A. Fertile branch. —B. Crumpled hairs on leaves. —C. Detail of inflorescence. —D. Individual flower. —E. Seed. A–E from the type *J. C. Soto Núñez 12678* (MEXU). Illustration by Albino Luna.

Paratypes. MEXICO. **Guerrero:** Mpio. Chichihualco [Mpio. Leonardo Bravo], 5 km al SW de Chichihualco, camino a Filo de Caballo, 18 Feb. 1982, *E. Martínez 44* (MEXU); ca. de Filo de Caballo, 19 Apr. 1985, *J. C. Soto 8264* (MEXU); Mpio. General Heliodoro Castillo, Canoas, 1 km al S de Cruz de Ocote, 23 May 1986, *J. C. Soto 12725* (MEXU); 1 km al S de Cruz de Ocote, 17°29′N, 100°07′W, 22 May 1987, *J. S. Miller 2861* (MEXU, MO); Mpio. Leonardo Bravo, Camino Filo de Caballo a Chichihualco, 14 km a partir del Hospital de Filo de Caballo, 17°35′18″N,

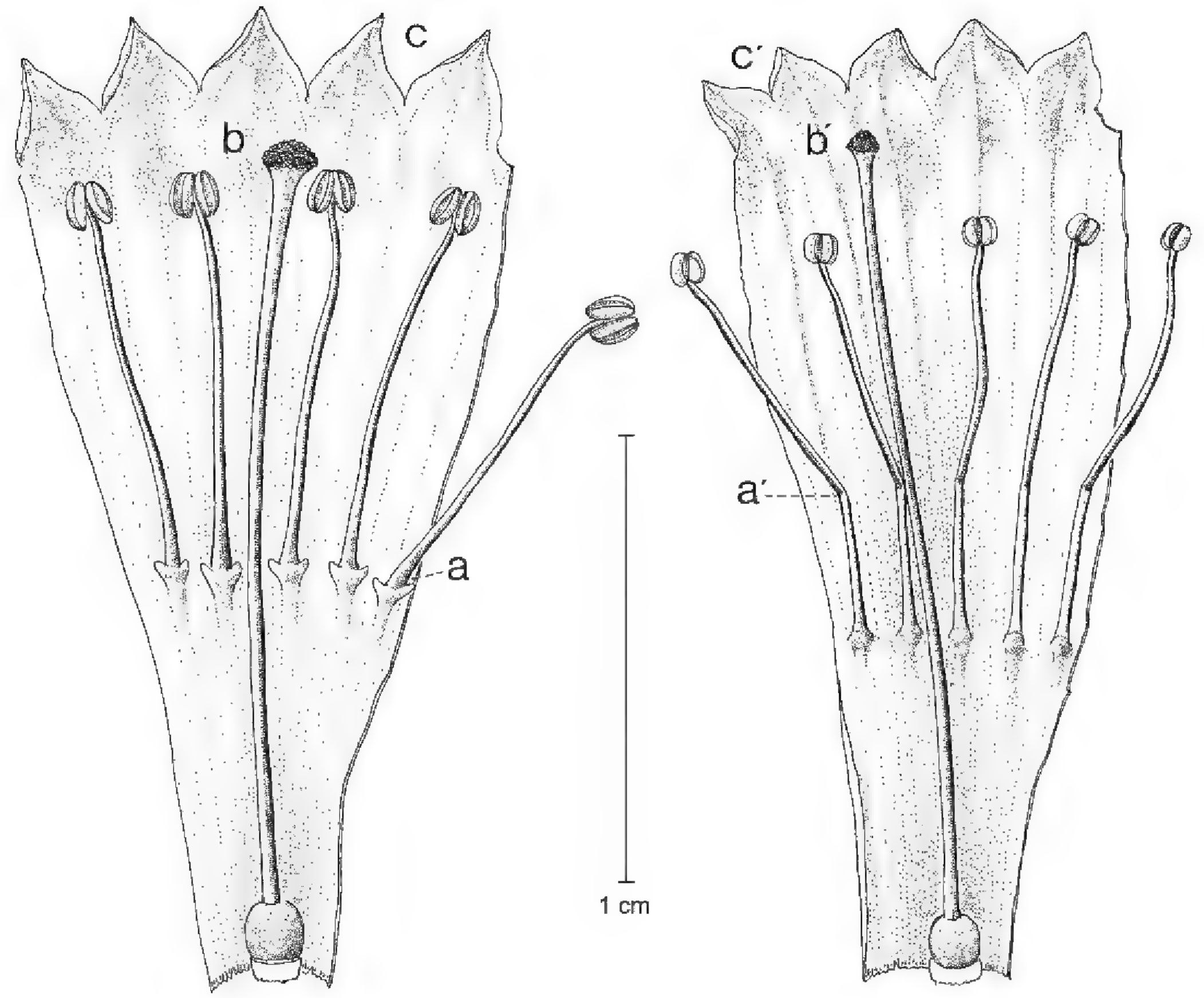

Figure 2. Comparison of characteristics that differentiate *Cestrum sotonunezii* Mont.-Castro (to the left, from the type *Soto Núñez 12678*, MEXU) from *C. flavescens* Greenm. (to the right, from *Pringle 6832*, MEXU). —A, A′. Stamen bases fused to corolla and position of filament bulge. —B, B′. Proportion between stamens and stigma. —C, C′. Size of corolla lobes. Illustration by Albino Luna.

99°47′53″W, 2 Mar. 2002, *J. C. Montero 213* (MEXU, MO, NY, US); Yextla, 7.4 km al SE, 17°32′37″N, 99°54′45″W, 7 July 1998, *B. González 1779* (FCME); 7 km del camino de Chichihualco a Filo de Caballo a partir de la gasolinería de Chichihualco, 10 May 2002, *J. C. Montero 223* (MEXU, NY); de Filo de Caballo a El Jilguero, desviación a Yextla, *J. Calónico 3516* (FCME). **Michoacán:** Mpio. Charo, Las Trojes, 19°39′10″N, 100°56′9″W, 21 Apr. 1986, *S. Zamudio 3874* (MEXU); Mpio. Hidalgo, 5 km antes del Caracol, 23 Apr. 1984, *J. C. Soto 6367* (MEXU); Mpio. Tzitzio, 2 km al S de El Mirador, Mil Cumbres camino a San Antonio Villalongín, 30 Mar. 1982, *E. Martínez-S 442* (MEXU).

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Neotypification of *Hybanthus longistylus* (Violaceae)

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ABSTRACT. Recent studies on South American *Hybanthus* Jacq. s.l. (Violaceae) revealed the need to select a neotype for the name *H. longistylus* Schulze-Menz, the holotype of which was destroyed in Berlin during World War II.

RESUMEN. Estudios recientes realizados en *Hybanthus* Jacq. s.l. (Violaceae) de Sud-América revelaron la necesidad para seleccionar un neotipo para el nombre *H. longistylus* Schulze-Menz, debido a que el holotipo fue destruido en Berlin durante la Segunda Guerra Mundial.

Key words: *Hybanthus*, neotype, Violaceae.

Hybanthus Jacq. s.l. is a predominantly tropical and subtropical genus of Violaceae, with its highest taxonomic diversity in Latin America. The broadest revisionary work for this genus was published by Schulze (1936) and comprised nearly all South American taxa (ca. 35) described at the time. Recent and ongoing taxonomic studies (Souza, 2002; Seo, 2008) reveal that this group is still poorly known, and many new species are yet to be described. Typification is needed for the name *H. longistylus* Schulze-Menz, as its type was among those collections at B (Botanischer Garten und Botanisches Museum, Berlin-Dahlem) destroyed during World War II.

Hybanthus longistylus was described by Schulze (1934: 108) based solely upon a collection by Fiebrig, cited as "Paraguay: Cordillera de Altos, Loma. Oktober 1902. K. Fiebrig 273. Herb. Berol." The specimen used by Schulze was most probably a unicate, since no duplicates have been found after extensive searches in nearly 80 consulted herbaria throughout the Americas and Europe. Personal searches by the authors in B confirmed that the holotype of *H. longistylus* was indeed destroyed during World War II. Due to the lack of existence of any original material and in accordance with the *International Code of Botanical Nomenclature* (McNeill et al., 2006: Art. 9.9) a neotype is here designated.

Hybanthus longistylus Schulze-Menz, Notizbl. Bot. Gart. Berlin-Dahlem 12(111): 108. 1934. TYPE: Argentina. Corrientes: Dpto. Concepción, Colonia Habana, rough grassland on high ground, sandy soil, 14 Nov. 1980, *T. M. Pedersen 12955* (neotype, designated here, CTES; duplicates, C not seen, G, MBM).

Discussion. The neotype chosen here was collected in Argentina, near the border with Paraguay, in a region with a vegetation type similar to where the original specimen was found. Furthermore, and more importantly, the selected neotype exactly corresponds to Schulze's (1934) original description, despite the morphological variability of the species complex to which *Hybanthus longistylus* belongs.

Hybanthus longistylus is distinguished by its opposite leaves and long style, which reaches up to 6 mm long. The taxon belongs to a complex group of species that are poorly delimited, especially in southern South America, where an astonishing diversity of form is found. In addition to this species, the group includes the opposite-leaved *H. glaucus* (Chodat) Schulze-Menz, *H. hieronymi* (Griseb.) Hassl., and *H. oppositifolius* (L.) Taub., with *H. glaucus* and *H. hieronymi* corresponding to the extremes of variability in this group, especially regarding leaf shape (elliptic and entire vs. lanceolate to ovate and serrate). Recent phylogenetic studies (Paula-Souza, 2009) suggest a close relationship among these species, as well as their close affinity with all other opposite-leaved species of South American *Hybanthus* s.l., four of which are also native to this area in southern South America.

The available data are still not sufficient for a critical treatment of this difficult species complex, which may also involve hybrid forms. According to Schulze's 1934 description, *Hybanthus longistylus* differed from all related species by its long style to 6 mm, twice as long as the stamens. Preliminary morphological observations indicate that the flowers in *H. longistylus* also tend to be slightly larger than in

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the related species *H. glaucus* (14–17 mm vs. 8.5–12.5 mm), but further and detailed analysis is needed in order to reach any definitive conclusion for synonymy.

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A New Monotypic Genus, *Ananthura*, from Tropical Africa (Asteraceae, Vernonieae)

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Abstract. A new genus, *Ananthura* H. Rob. & Skvarla (Asteraceae, Vernonieae), is described for *Vernonia pteropoda* Oliv. & Hiern in Oliv. of Central Africa. The genus has broad median shields on the involucral bracts and lophate, strongly tricolporate pollen. It is placed in the subtribe Gymnantheminae. The name *V. urophylla* Muschl. is lectotypified.

Key words: Africa, *Ananthura*, Asteraceae, Gymnantheminae, IUCN Red List, Vernonieae.

The realization that the genus *Vernonia* Schreb. (Asteraceae) is restricted to the Western Hemisphere, mostly in North America, has led to the need for alternative dispositions of all Asian and African species (Robinson, 1999a) and most of the tropical American species (Robinson, 1999b) that were placed in that genus. The process of providing those alternative dispositions continues here with the placement of the species *V. pteropoda* Oliv. & Hiern in Oliv. in a new monotypic genus, *Ananthura* H. Rob. & Skvarla, which has a distinctive appearance (Fig. 1) and shows a unique combination of involucral and palynological characteristics. The broad median shields on the involucral bracts place the genus in the subtribe Gymnantheminae, where it is distinguished by the strongly lophate tricolporate pollen (Fig. 2).

Methods

Specimens examined were from the U.S. National Herbarium in Washington, D.C. Microscopic structures were examined mostly using material mounted in Hoyer's solution (Anderson, 1954). Preparation of pollen for scanning electron microscopy (SEM) consisted of acetolysis (Erdtman, 1960) followed by the osmium-thiocarbohydrazide procedure (Chissoe et al., 1995) and pulse sputter-coating with a gold:palladium (60:40) target (Chissoe & Skvarla, 1996). Examination was performed at the University of Oklahoma with a JEOL 880 SEM (JEOL Ltd., Tokyo, Japan) equipped with a lanthanum hexaboride (LaB_6) electron source operating at 15 KV.

Results and Discussion

Jeffrey (1988: 213–215) placed *Vernonia pteropoda* in his Group 2 subgroup B, a group he described as "...a large, ill-defined subgroup of Afroasian species, characteristically rather weak often decumbent or ± scandent shrubs but sometimes attaining tree stature." Jeffrey placed the species in the first aggregate within his subgroup, an aggregate stated to have "persistent inner phyllaries and ± 10-ribbed achenes." Jeffrey cited Kingham (1976) in saying all members of his subgroup B had subechinolophate to echinate, tricolporate, micropunctate pollen grains. The aggregate of Jeffrey included a mixture of species, some now placed in the Vernonian subtribe Erlangeinae and some in the subtribe Gymnantheminae (Keeley & Robinson, 2009). Among the species in the group defined by Jeffrey (1988), *V. pteropoda* seems to stand alone without any immediate relatives.

Vernonia pteropoda is a singularly distinctive species with a herbaceous to weakly suffrutescent habit, leaf blades with sharply and closely serrate margins, slenderly acuminate leaf tips, and a long petiole that has a tapered narrow wing reaching almost to the base. Identification of the species on which the genus is based is not a problem. Relationship to the Gymnantheminae also seems confirmed by the involucral bracts having broad median shields with no discrete median costa or keel. Such involucral bracts place the genus in the subtribe Gymnantheminae in both the broad sense of that subtribe in Robinson (1999a, 2007) and the narrower sense of Keeley and Robinson (2009).

Placement of *Vernonia pteropoda* in the genus *Gymnanthemum* Cass., a genus of mostly shrubby plants, might be possible except for the herbaceous habit and pollen morphology of *V. pteropoda*.

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Figure 1. *Ananthura pteropoda* (Oliv. & Hiern in Oliv.) H. Rob. & Skvarla (*J. D. & E. G. Chapman 9282*, US) showing habit of plant.

Gymnanthemum also tends to have distinctly deciduous inner involucral bracts, while the bracts of the new genus seem comparatively persistent. The strongly lophate pollen is particularly notable in distinguishing these taxa.

In the overly broad concept of *Gymnanthemum* in the first attempt to delimit the genus (Robinson, 1999a), plants with both sublophate (Skvarla et al., 2005) (Type A of Jones [1979, 1981] and Keeley & Jones [1977, 1979]) and lophate (Blackmore et al.,

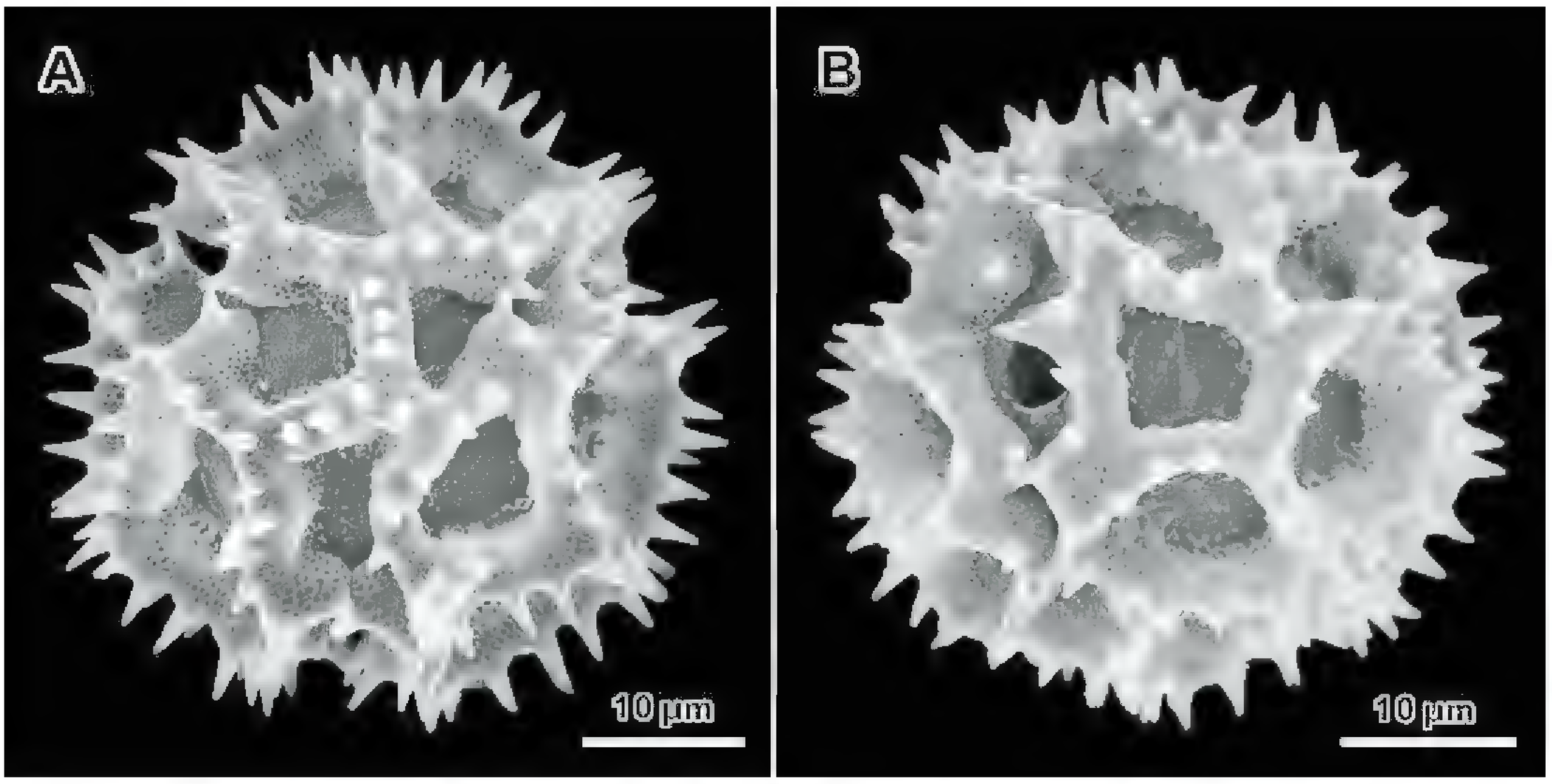

Figure 2. Scanning electron micrographs of pollen of *Ananthura pteropoda* (Oliv. & Hiern in Oliv.) H. Rob. & Skvarla (*J. D. & E. G. Chapman 9282*, US). —A. Polar view of pollen grain showing three colpi meeting at pole. —B. Lateral view of grain showing pore and intercolpus.

2009) types of pollen were included. All of the forms of pollen in the genus were tricolporate; there were none of the triporate types that occur in the subtribe Erlangeinae (Keeley & Robinson, 2009). Although tricolporate sublophate pollen is found in almost all groups of the Vernonieae, the Erlangeinae have no lophate types that are strongly tricolporate. It was in a more recent study that the lophate forms of pollen initially credited to *Gymnanthemum* were found to characterize a thoroughly distinct genus, *Monosis* DC. in Wight (Robinson & Skvarla, 2006). At this time, *Gymnanthemum* is known to have exclusively sublophate pollen with a continuous perforated tectum in the noncolpar areas, although that pollen has well-developed incipient lacunae. The pollen of the new genus, *Ananthura* (Fig. 1), is of a tricolporate lophate form, with sharply delimited muri bearing regularly aligned spinules. The new genus has pollen more like *Linzia* Sch. Bip. ex Walp. of the subtribe Linziinae, having short spur muri intruding into the colpi above and below the pores. The subtribes Linziinae and Gymnantheminae are considered closely related (Keeley & Robinson, 2009), but placement of *Vernonia pteropoda* in *Linzia* is negated by the presence of the shields on the involucral bracts in *Ananthura* and by the lack of the series of pectinate denticulations on the lateral margins of the involucral bracts that are characteristic of *Linzia*. Unlike many members of the Erlangeinae, all of the pollen types in the Gymnantheminae and Linziinae, including the new genus, have a perforated tectum, at least on the muri.

Confirmation of the general placement of the genus from either DNA sequences (Keeley et al., 2007) or from secondary metabolite chemistry (probable presence of elemanolide rather than glaucolide sequiterpene lactones or 5-methylcoumarins [Bohlmann & Jakupovic, 1990]) is presently lacking, but the species is singularly distinctive and the genus cannot be mistaken for any of the related genera.

The leaves of *Ananthura* alone will distinguish the taxon. The leaf blade is membranaceous to thinly herbaceous and ovate to elliptic, with irregularly closely and sharply serrate margins; the leaf tip is abruptly and narrowly long-acuminate. The most distinctive feature is the long, winged petiole of the leaf. Also distinctive in the species is the regular fringe of short, small, crowded teeth that form the outer series of the pappus that persists after the fragile inner pappus has been lost. In appearance, that persistent outer pappus is reminiscent of the teeth on the mouth of a polytrichaceous moss capsule.

The new genus is named after a final rather distinctive characteristic, the completely blunt, unappendaged, ecaudate, but calcarate bases of the anther thecae. In this character the genus differs from *Gymnanthemum* and *Brenandendron* H. Rob. of the Gymnantheminae, which have basal appendages, and is more like *Linzia*, which lacks them.

Ananthura H. Rob. & Skvarla, gen. nov. TYPE: *Vernonia pteropoda* Oliv. & Hiern in Oliv.

Genus novum *Gymnanthemo* Cass. simile, sed ab eo habitu herbaceo, bracteis involucri aliquanto persistentibus et granis pollinis lophatis tricolporatis distinctum.

Herbs to weak subshrubs on forest floors, to 1.4 m tall, with few or no lateral branches; stems terete, striated, with narrow solid pith, surface sparsely puberulous with multicellular uniseriate hairs. Leaves alternate, petioles to 8 cm, with tapering wings reaching nearly to the base; blade membranaceous to thinly herbaceous, ovate to elliptic, to 15 cm, base attenuate into wings of petiole, margins irregularly sharply and closely single or double serrate, teeth with slender callose tips, apex strongly long-acuminate into slender tip to 2 cm; adaxial surface of lamina and wings sparsely pilosulose, denser on midvein and secondary veins, abaxial surface puberulous, spreading pilosulose on veins, with numerous yellowish glandular dots on surface; venation pinnate, with 6 or 7 arching secondary veins. Inflorescence terminal, and from axils of upper leaves, with decrescent foliiform bracts on main axis, branches slender, widely spreading below, distal branches more ascending, with few ribs, puberulous with numerous yellow glandular dots, distal branches more slender and shorter, peduncles mostly 5–10 mm. Heads cylindrical at anthesis, 5–6 mm wide; involucres mostly ca. 8 mm high; bracts in 4 to 5 gradate series, appressed, persistent until late in fruiting, imbricate, ca. 1–7 mm, broadly ovate to oblong with blunt or rounded narrowly scarious tips, essentially glabrous, except for small hairs and glandular dots in subapical often green patch, large median area of outer surface essentially smooth and usually pale greenish or brownish with age, usually with 3 longitudinal rather dark lines, margins entire, lateral margins broadly scarious; receptacle flat, alveolate, glabrous. Florets ca. 15 in a head; corollas white, narrowly funnelform, ca. 9 mm, mostly glabrous, basal tube filiform, ca. 4 mm, upper broadened part above filament insertions ca. 2 mm, lobes narrow, ca. 3 mm, slightly scabridulous with minute antrorse hairs near tip; anther thecae ca. 2 mm, calcarate bases ecaudate, without tail or fringe, apical appendage oblong-ovate; style with narrow sclerified annulus at base, apical style branches slender with sweeping hairs on whole outer surface and on upper ca. 0.5 mm of style shaft. Achenes 2.2–2.5 mm, prismatic, ca. 8-ribbed, ribs persistently yellow as they mature, surface hispidulous with minute hairs, walls internally with numerous minute subquadrate to rounded raphids; inner pappus bristles capillary, ca. 5 mm, slender, fragile, minutely barbellate, outer pappus a row of close-set minute, persistent teeth ca. 0.2 mm.

Pollen grains (Fig. 2) are spherical, 35–37 μm diam. when dry, tricolporate, lophate, colpi meeting at the poles, lacunae in each intercolpus in 1:2:2:1 pattern; muri well-defined, with regular rows of 3 or 4 spinules along each crest, subtended by bacculae under muri, not rhizomate, firmly attached to footlayer; perforated tectum present on muri but lacking on floors of lacunae.

Ananthura pteropoda (Oliv. & Hiern in Oliv.) H. Rob. & Skvarla, comb. nov. Basionym: *Vernonia pteropoda* Oliv. & Hiern in Oliv., Fl. Trop. Afr. 3: 283. 1877. TYPE: Malawi. Mt. Chiradzura, 1860–1863, *C. J. Meller s.n.* (holotype, K).

Vernonia urophylla Muschl. in Engl., Bot. Jahrb. Syst. 46: 86. 1911. TYPE: Tanzania. Derema, 1899, *G. Scheffler 77* (lectotype, designated here, BM).

Distribution and habitat. *Ananthura pteropoda* is known from Kenya, Tanzania, Congo, Mozambique, Malawi, Zambia, and Zimbabwe (Jeffrey, 1988). The taxon has been observed as gregarious in the understory of midaltitude forests.

IUCN Red List category. *Ananthura pteropoda* is known from many localities, but all are in possibly endangered forested areas. The conservation status according to IUCN Red List criteria (IUCN, 2001) is Not Evaluated (NE).

Etymology. The species name for *Ananthura pteropoda* derived from the long, winged petiole of the leaf. The name of the synonym, *Vernonia urophylla*, is derived from the long slender tip of the leaf.

Note. The syntype at BM is selected as the lectotype for *Vernonia urophylla*. Two other syntypes (*Engler 832*, *Warnecke 425*) were both destroyed at B.

Specimens seen. MALAWI. Nyassaland, 1891, *Buchanan 11.49* (K, US); Cholo Distr., Cholo Mtn., 1300 m, 20 Sep. 1946, *Brass 17679* (NY, US); Zomba Plateau, Chiradzulu Peak, near fire tower, 13 Oct. 1983, *Balaka & Gowa 293* (US); southern Malawi, Mt. Mulanje, Muluzi Valley, Chisongeli Forest, 1320 m, 13 Sep. 1988, *J. D. & E. G. Chapman 9282* (MO, US). TANZANIA. "Uluguru Urwald sudöste von Mission Schlesein über Norogoro," 1600 m, 1 Nov. 1914, *Peter O II 104* (US).

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Fagopyrum wenchuanense and *Fagopyrum qiangcai*, Two New Species of Polygonaceae from Sichuan, China

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ABSTRACT. *Fagopyrum qiangcai* D. Q. Bai and *F. wenchuanense* J. R. Shao, two new species of Polygonaceae from Wenchuan County, Sichuan Province, China, are described and illustrated. *Fagopyrum qiangcai* is closely related to *F. esculentum* Moench based on its leafy base, triangular leaves, and terminal or axillary racemes. The new species differs in having congested nodes at the base of the plant, triangular to oval terminal leaves with bright red veins, dense inflorescences, white punctate adaxial leaf surfaces, and an articulate pedicel. *Fagopyrum qiangcai* is diploid, $2n = 2x = 16$, with a karyotype of 12 metacentric and four submetacentric chromosomes. *Fagopyrum wenchuanense* is closely related to *F. gracilipes* (Hemsl.) Dammer ex Diels but differs in its caespitose habit, the plants often with prostrate stems. Its leaves vary from broadly cordate to ovate to hastate or long hastate, the pedicels are basally puberulent, the stamens and pistils are variable in length, and the capsules are ellipsoid-triangular or broadly ovoid-triangular, 3–3.5 × 2.5–3 mm. *Fagopyrum wenchuanense* is diploid, $2n = 2x = 16$, with a karyotype of 16 metacentric chromosomes.

Key words: China, *Fagopyrum*, IUCN Red List, Polygonaceae, Sichuan.

Buckwheat belongs to the Old World genus *Fagopyrum* Mill. (Polygonaceae). It is an annual herbaceous plant with origins in China and Central Asia; it is most diverse in China, where 10 of its 16 species are found (Li, 1998; Ohnishi, 1998). In southern China, buckwheat is an important crop that provides security to traditional farmers under subsistence farming practices. Owing to its frost resistance, short growth period, and undemanding cultivation, buckwheat is common in high-altitude areas at ca. 2000 m, and in Tibet it is found at elevations of up to 4500 m (Wang, 1989; Ohnishi & Yasui, 1998). Ohnishi (1998) reported that the cultivated common buckwheat originated in the region from southwestern China to the Himalayas. In July 2006, we found two new species of wild-type buckwheat, here described as *F. qiangcai* D. Q. Bai and *F. wenchuanense* J. R. Shao, in Wenchuan County, Aba Prefecture, Sichuan Province, China. In this paper, we discuss the morphological characteristics and karyotypes of these new species and their relationships to existing species.

MATERIALS AND METHODS

Species of the two new buckwheat taxa were collected in July 2006 and cultivated at Sichuan Agricultural University. Selected seeds were soaked in distilled water and germinated at 25°C for 24 hr. until root tips were 1–2 cm long. Primary roots were pretreated in ice water for 27 hr., fixed for 24 hr. in 3:1 glacial acetic acid:ethanol solution, rinsed with distilled water, and hydrolyzed in 1 mol/L HCl at 25°C for 8–15 min. After rinsing, the root tips were squashed in phenol rosaniline, and five well-scattered metaphase plates of each genotype were selected for karyotype analysis. Karyotype averages were calculated using the method described by Li and Chen (1985); the chromatid classification was determined according to Stebbins (1971).

TAXONOMIC RESULTS

1. Fagopyrum qiangcai D. Q. Bai, sp. nov. TYPE: China. Sichuan: Aba State, KeKu town, in thick growth of grass on slopes, 1580 m, 16 July 2006, *J. R. Shao & D. Q. Bai Ghassot 4396* (holotype, SAU). Figure 1.

Haec species basi foliata, foliis sagittatis et racemis axillaribus vel terminalibus *Fagopyro esculento* Moench similis, sed ab eo nodis congestis prope plantae basin, foliis albo-maculatis nervis phoeniceis, pedicello articulato et inflorescentia densa non interrupta differt.

Plants annual, herbaceous, 15–45 cm, with dense, short internodes at or near the base of the plant,

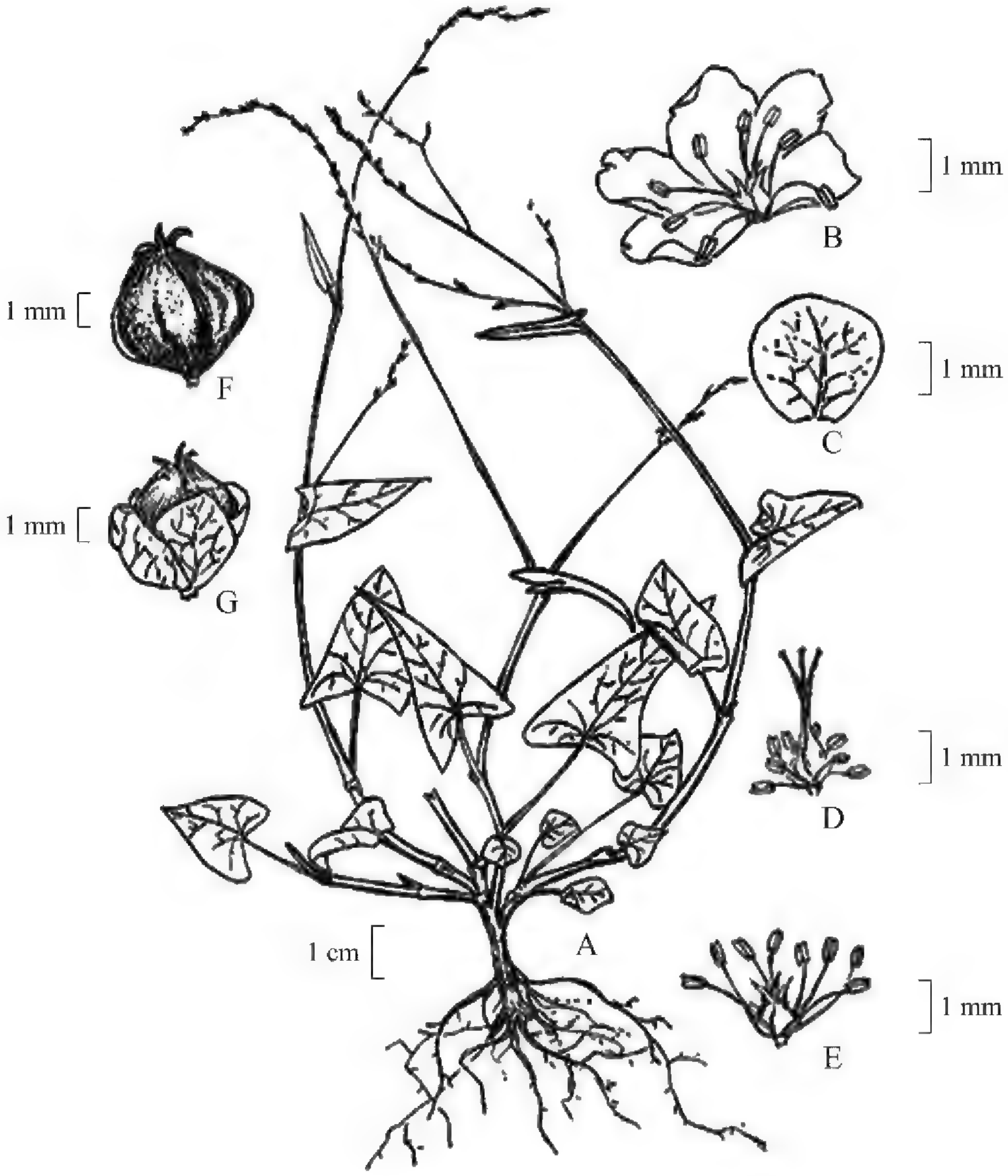

Figure 1. *Fagopyrum qiangcai* D. Q. Bai. —A. Plant habit. —B. Intact flower. —C. Perianth segment. —D. Long-styled flower, with the perianth removed. —E. Short-styled flower, with the perianth removed. —F. Achene, with the perianth removed. —G. Achene enveloped by the persistent perianth. A–F drawn by D. Yan from the holotype, *J. R. Shao & D. Q. Bai Ghassot 4396* (SAU).

multi-branching; stems erect, pinkish red in color, terete, with a number of longitudinal ribs. Leaves simple, alternate, sagittate, green or gray-green with white spots on the adaxial surface, with 5 to 7 pairs of basal nerves and (4)5 to 7 pairs of lateral nerves, bright red on young leaves; petioles on basal and cauline leaves (0.5–)1.2–1.5(–4) cm, reddish brown or brown-green, slightly grooved longitudinally; terminal leaves sessile, papery, triangular to oval, (0.8–)1.2–4(–4.6) × (0.8–)1.2–4.5(–5.1) cm, apex acuminate, base truncate or retusely truncate; ocreae thick-membranous, obliquely tubular, 5–9 mm, with 9 to 15 green longitudinal veins, apex acuminate to caudate. Inflorescence racemose, terminal or extra-axillary, sometimes a panicle, 1–10 cm, axis cylindrical, red to reddish brown; flowers densely packed on axis at intervals of (0.1–)0.12–1.4 cm; bracts obliquely funnel-shaped, 2–3 mm, with 3 prominent green veins, the central vein coarse, projecting above bract as an awn. Flowers bisexual,

heterostylous, perianth segments 5, obovate to ovate, 3–5 mm, iridescent, pink; stamens 8, anthers orange-brown or brown, oval, filaments linear, ca. 0.6 mm in flowers with long styles, ca. 2 mm in flowers with short styles; stigmas 3, ca. 1.3 mm in flowers with long styles, ca. 0.5 mm in flowers with short styles; ovary superior, ovoid, trigonous, ca. 0.7 × 0.5 mm (diam.). Achene black or black-brown, broadly ovoid, trigonous, 3.5–6 mm, broadly ovoid fruit with reticulate surface, apex obtuse, base rounded, with a clearly projecting ridge, tightly enclosed by persistent perianth; persistent styles recurved, closely clinging to the fruit.

Distribution, habitat, and phenology. The known distribution area of *Fagopyrum qiangcai* is confined to the hillside of a dry river valley between Wenchuan and Li counties, Sichuan Province, China. Other wild species of buckwheat are rare in this area. The climate is extremely dry, and the soil is alkaline. Plants were observed in flower from July to October and in fruit from August to November.

IUCN Red List category. Although *Fagopyrum qiangcai* is restricted to Wenchuan and Li counties, we assess it here as Least Concern (LC) according to IUCN Red List criteria (IUCN, 2001), because of its relatively extensive distribution and the protected nature reserves in the areas in which it was collected.

Etymology. The indeclinable epithet of the new species is from the Pinyin and refers to the color of the leaves, with the veins bright red on young leaves and the adaxial leaf surfaces with white spots.

Karyotype. Ideograms of chromosomes at mitotic metaphase are shown for *Fagopyrum qiangcai* and *F. esculentum* Moench (Fig. 2E–H). The somatic chromosomes of *F. qiangcai* indicate that it is a diploid taxon, with a chromosome number of $2n = 2x = 16$; 12 chromosomes are metacentric, four chromosomes are submetacentric, and none are accompanied by satellites. The somatic chromosomes of *F. esculentum* show that this taxon is also diploid, with a chromosome number of $2n = 2x = 16$; all 16 chromosomes are metacentric and have no satellites. The karyotype of these two species can be classified as Stebbins's category 1A. Stebbins proposed that the evolutionary tendency of the karyotype in higher plants progressed from symmetry to asymmetry, suggesting that the species with a greater number of metacentric chromosomes evolved first (Stebbins, 1971). This theory would suggest that *F. qiangcai* evolved before *F. esculentum*.

Paratype. CHINA. **Sichuan:** Aba State, KeKu town, in thick growth of grass on slopes, 1580 m, 16 July 2006, *J. R. Shao & D. Q. Bai Ghassot 4218* (SAU).

2. Fagopyrum wenchuanense J. R. Shao, sp. nov. TYPE: China. Sichuan: Aba, Wenchuan Co., Mianchi, on low banks betw. fields, 30°45′–31°43′N, 102°51′–103°44′E, 1190 m, 16 Sep. 2006, *J. R. Shao & D. Q. Bai Ghassot 4217* (holotype, SAU). Figure 3.

Species *Fagopyro gracilipedi* (Hemsl.) Dammer ex Diels affinis, sed ab eo plantis ramosissimis plerumque caespitosis, caulibus et ramis plerumque obliquis vel prostratis, foliis late cordatis vel ovatis usque longe hastatis, pedicellis basi pubescentibus, staminibus et pistillis inaequilongis atque acheniis ellipsoideo-triangulis vel late ovoideo-triangulis 3 3.5 × 2.5 3 mm differt.

Plants annual, herbaceous, 27–170 cm, multiple branching from basal or lower nodes; all nodes leafy; stems terete or nearly so, slender, usually obliquely positioned or prostrate, rarely erect, longitudinally lineate, green to green-brown or purple-brown, glabrous; internodes 1.5–7.6 cm. Leaf blades chartaceous, broadly cordate to ovate, ovate-hastate to triangular-hastate, or hastate to long hastate; leaves diminishing in size acropetally, (1.3–)2.1–6.5 × 1.5–5.5 cm; leaf apices acuminate to long acuminate to tail-like acuminate, base ± cordate, occasionally deeply so, the 2 lateral blade segments usually larger, rounded; adaxial blade surfaces green or deep green, abaxial surfaces green or gray-green, sparsely puberulent on both surfaces; basal veins 7 to 9, lateral veins 6 to 11; petioles on lower leaves 2.2–5 cm, but diminishing apically, 0.5–2.2 cm, green, glabrate, sometimes puberulent and concave-grooved above, rounded or rounded-convex below; leaf sheaths semi-membranous, oblique, funnel-shaped, 3–6 mm, apex ± acuminate to mucronate, with 5 to 11 small green veins. Inflorescences racemose, axillary and terminal, 1.7–14.5 cm; rachis slender, quadrate, green, glabrous, bracts sometimes present at middle nodes or higher; bracts leaflike, 1–1.3 × 0.6–0.7 cm, ovate, acuminate or mucronate; flowers arranged laxly, with internodes 0.3–2 cm apart, rachis ca. 4 mm diam. after flowering, floral bracts oblique, funnel-shaped, 2.3–3 mm, with 3 to 7 green veins, the middle vein extending as an apical mucro, 0.3–1 mm long, 3 to 5 florets subtended by each bract; pedicels linear, 2.5–5 mm, greenish or yellow-green, basally puberulent. Flowers with 5 perianth segments, these white, deeply dissected, and green at base, the midvein evident and included, lateral venation evident; stamens 8, unequal, arranged in 2 whorls, with 5 outside and 3 inside, filaments linear, 1–2 mm, glabrous, anthers elliptic, 0.2–0.3 cm, glabrous, purple-brown; pistil unequally long, the ovary ovate to trigonous, ca. 0.5 mm, styles 3, linear, glabrous, the stigma small, capitate. Capsules

Figure 2. —A. *Fagopyrum wenchuanense* J. R. Shao, root tip cell chromosomes. —B. *F. gracilipes* (Hemsl.) Dammer ex Diels, root tip cell chromosomes. —C. *F. wenchuanense*, ideograms. —D. *F. gracilipes*, ideograms. —E. *F. qiangcai* D. Q. Bai, root tip cell chromosomes. —F. *F. esculentum* Moench, root tip cell chromosomes. —G. *F. qiangcai*, ideograms. —H. *F. esculentum*, ideograms. A, C from *Bai Ghassot 4472*; B, D from *Bai Ghassot 4491*; E, G from *Bai Ghassot 4483*; F, H from *Bai Ghassot 4475* (all at SAU).

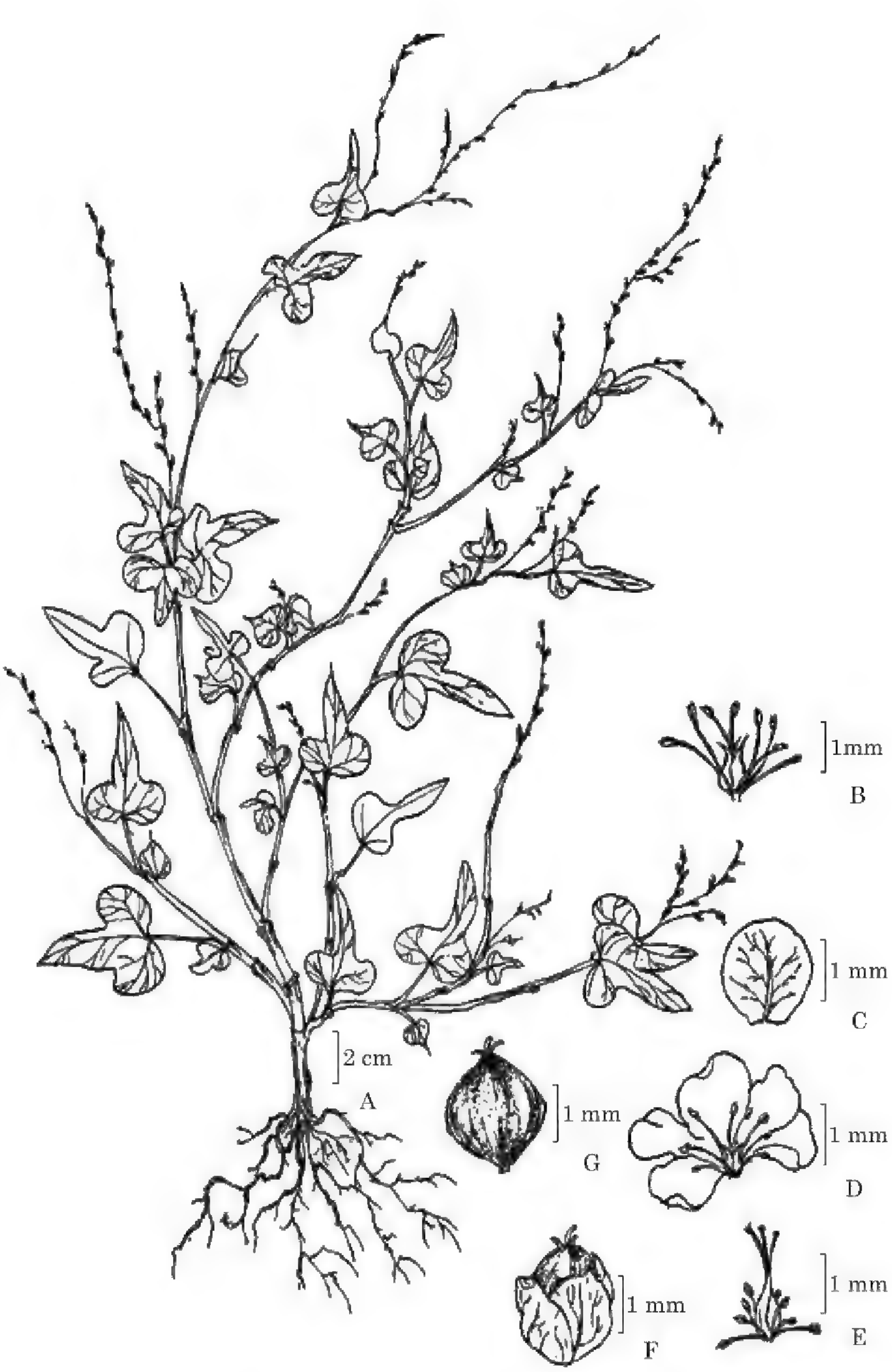

Figure 3. *Fagopyrum wenchuanense* J. R. Shao. —A. Plant habit. —B. Dissection of short-styled flower. —C. Perianth segment. —D. Intact flower with perianth segments remaining. —E. Dissection of long-styled flower. —F. Capsule enveloped by persistent perianth. —G. Capsule with perianth removed. A–G drawn by Wei Hou from the holotype, *J. R. Shao & D. Q. Bai Ghassot 4217* (SAU).

elliptic-triangular or broadly ovate-triangular, less often broadly ovate-rectangular or elliptic-rectangular, 3–3.5 × 2.5–3 mm, red-brown to black at maturity, perianths closely enveloping the fruit and persistent, styles persistent, recurved.

Distribution, habitat, and phenology. The known distribution area of *Fagopyrum wenchuanense* is confined to portions of Wenchuan County, Aba Prefecture, Sichuan Province, China. Plants were observed in flower from August to October and in fruit from September to November.

IUCN Red List category. Although *Fagopyrum wenchuanense* is restricted to Wenchuan County in Sichuan Province, China, we assess the new taxon here as Least Concern (LC) according to IUCN Red List criteria (IUCN, 2001). This is based on its relatively extensive distribution and the protected nature reserves in which it was collected.

Etymology. The specific epithet refers to the type locality of the new species in Wenchuan County, Sichuan Province, China.

Karyotype. Ideograms of chromosomes at mitotic metaphase are shown for *Fagopyrum wenchuanense* and *F. gracilipes* (Hemsl.) Dammer ex Diels (Fig. 2A–D). The somatic chromosomes of *F. wenchuanense* indicate that the species is a diploid taxon, with a chromosome number of $2n = 2x = 16$, and all 16 chromosomes are metacentric. The somatic chromosomes of *F. gracilipes*, on the other hand, show that it is tetraploid with a chromosome number of $4n = 4x = 32$, with 30 metacentric and two submetacentric chromosomes. Both species have no satellites. The karyotype of these two species can be classified as Stebbins's category 1A (Stebbins, 1971).

Paratype. CHINA. **Sichuan:** Aba State, KeKu town, in thick growth of grass on slopes, 1580 m, 16 July 2006, *J. R. Shao & D. Q. Bai Ghassot 4218* (SAU).

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A New Species of *Epimedium* (Berberidaceae) with 24 Chromosomes from Guizhou, China

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ABSTRACT. The new species *Epimedium yinjiangense* M. Y. Sheng & X. J. Tian (Berberidaceae) is described from Guizhou Province, China. It is similar to *E. acuminatum* Franch. but differs in its chromosome count of $4n = 24$, as well as in its leaves, flowers, and inflorescences.

Key words: China, *Epimedium*, Guizhou, IUCN Red List, tetraploid.

Barrenwort is a perennial plant of the genus *Epimedium* L. (Berberidaceae), known in Chinese as Yinyanghuo, Xianlinpi, and Yangheye (Xie & Sun, 2006); it is known in traditional Chinese medicine to be effective in strengthening the kidneys and curing rheumatism and is widely used for the treatment of osteoporosis, hypertension, and coronary heart disease (Guo & Xiao, 1999), as well as to strengthen immunity and prevent dementia. Icariin flavonoids from *Epimedium* have been shown to inhibit the growth of cancer cells (Zhang et al., 2002; Xie & Sun, 2006). There are more than 60 species of *Epimedium* worldwide, distributed from the Mediterranean region, through western Asia, and into China and Japan (Ying, 2002). The center of diversity for the genus is in China (Ying, 2002), and 52 taxa of *Epimedium* were reported as native to China (Guo et al., 2008). The genus has been divided into two subgenera, with four sections that are determined geographically (Stearn, 2002). Species native to China are grouped within *Epimedium* sect. *Diphyllon* (Kom.) Stearn, as is the new species assigned here.

During field investigations and herbarium studies, two collections of *Epimedium* from Yinjiang County, Guizhou Province, were found to subtly differ morphologically, with distinct inner sepals and a tetraploid chromosome count unlike other *Epimedium* in China. Based on review of the taxonomic literature, including the *Flora of China* (Ying et al., 2011), as well as cytological studies, we conclude that these specimens represent a new species.

Epimedium yinjiangense M. Y. Sheng & X. J. Tian, sp. nov. TYPE: China. Guizhou: Tongren, Yinjiang, Taozizhai, nearby brooks in valley, 1300 m, 28°02′E, 108°42′15″N, 5 Mar. 2004, *M. Y. Sheng 040308* (holotype, GNUG; isotype, N). Figures 1, 2A, B.

Haec species *Epimedio acuminato* Franch. affinis, sed ab eo foliolis crasse carnosis (non coriaceis) abaxialiter glabris (non dense pilosis), pedunculis et pedicellis glabris (non sparse villosis), sepalis interioribus albis (non pallide roseis) margine corrugatis atque chromasomatum numero tetraploideo (non diploideo) differt.

Perennial herbs, 40–60 cm tall; rhizomes rigid, tuberculate, shoots creeping, 6–10 mm diam.; stems erect, terete, fistulose, smooth, 4–8 mm diam. Leaves basal and cauline, trifoliolate; leaflets thick, fleshy, ovate to narrowly ovate, 4.1–5.6 × 2.1–2.7 cm, adaxially smooth, abaxially glabrate, bases deeply cordate, the terminal leaflet with equal, rounded lobes, the lateral leaflets oblique with outer lobes larger and rounded, inner lobes also rounded at base, margins finely spinose-serrate, apex long acuminate. Fertile stems with 2 trifoliolate, opposite leaves; panicle 30- to 50-flowered, 15–25 cm, with lower peduncles loosely 4- to 8-flowered, glabrous; pedicels 3–4.5 cm. Flowers large, 2–4 cm diam.; outer sepals 4, obovate, 4–5.5 × 3–4 mm, caducous; inner sepals ovoid to widely ovoid, occasionally narrowly so, white, occasionally light mulberry-purple, 10–18 × 7–11 mm, margin corrugated; petals incurving, a little longer than inner sepals, spurred, the calcar or spur slender, elongate, incurved or slightly so, 13–20(–25) mm, white or light mulberry-purple; stamens yellow, ca. 4.5 mm; anthers ca. 3.2 mm, valvate, revolute. Capsule ca. 2 cm; style long rostrate, persistent; seeds numerous.

Distribution and habitat. Epimedium yinjiangense is endemic to northwestern Guizhou Province in China and is known only from the area of the type locality. Specimens of *E. yinjiangense* were collected

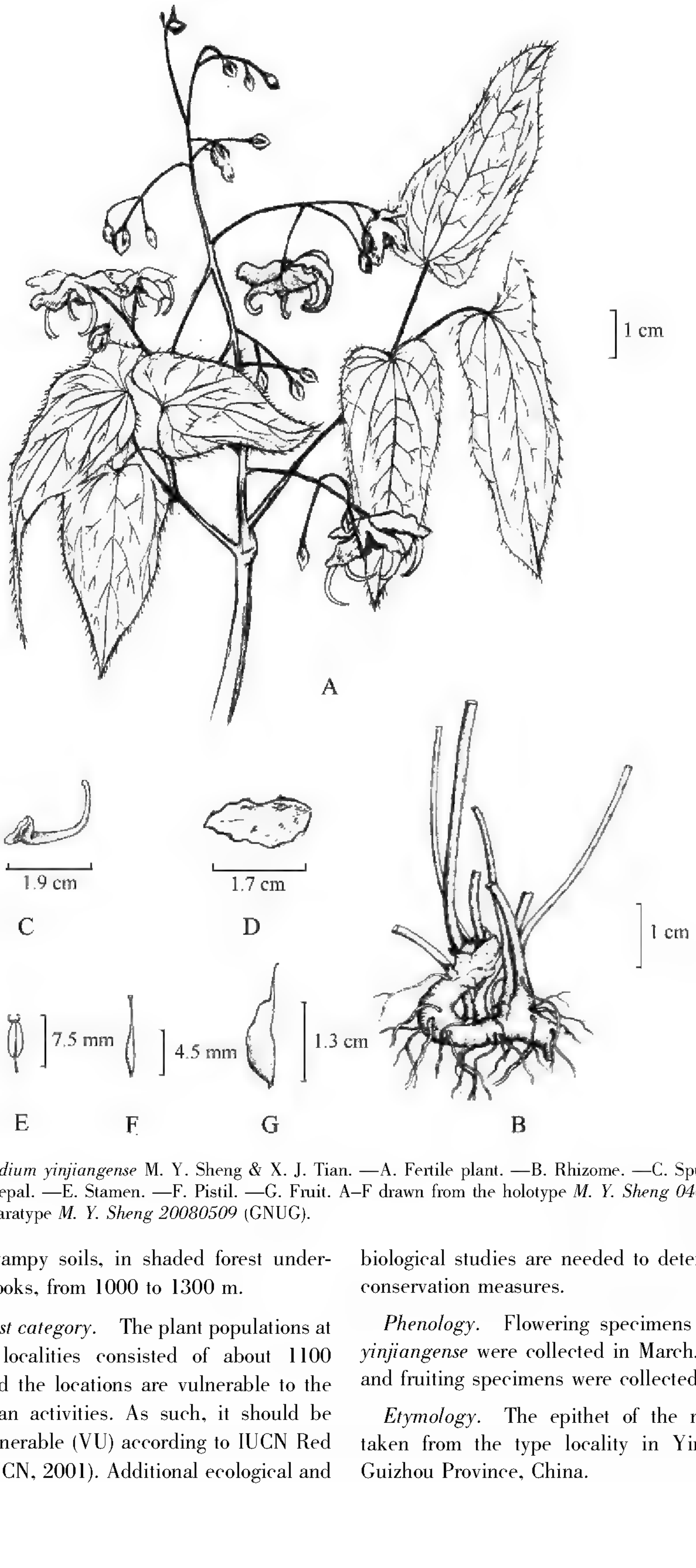

Figure 1. *Epimedium yinjiangense* M. Y. Sheng & X. J. Tian. —A. Fertile plant. —B. Rhizome. —C. Spurred petal. —D. Corrugate inner sepal. —E. Stamen. —F. Pistil. —G. Fruit. A–F drawn from the holotype *M. Y. Sheng 040308* (GNUG); G drawn from the paratype *M. Y. Sheng 20080509* (GNUG).

from damp, swampy soils, in shaded forest undergrowth near brooks, from 1000 to 1300 m.

IUCN Red List category. The plant populations at the two type localities consisted of about 1100 individuals, and the locations are vulnerable to the effects of human activities. As such, it should be considered Vulnerable (VU) according to IUCN Red List criteria (IUCN, 2001). Additional ecological and biological studies are needed to determine effective conservation measures.

Phenology. Flowering specimens of *Epimedium yinjiangense* were collected in March, and flowering and fruiting specimens were collected in May.

Etymology. The epithet of the new species is taken from the type locality in Yinjiang County, Guizhou Province, China.

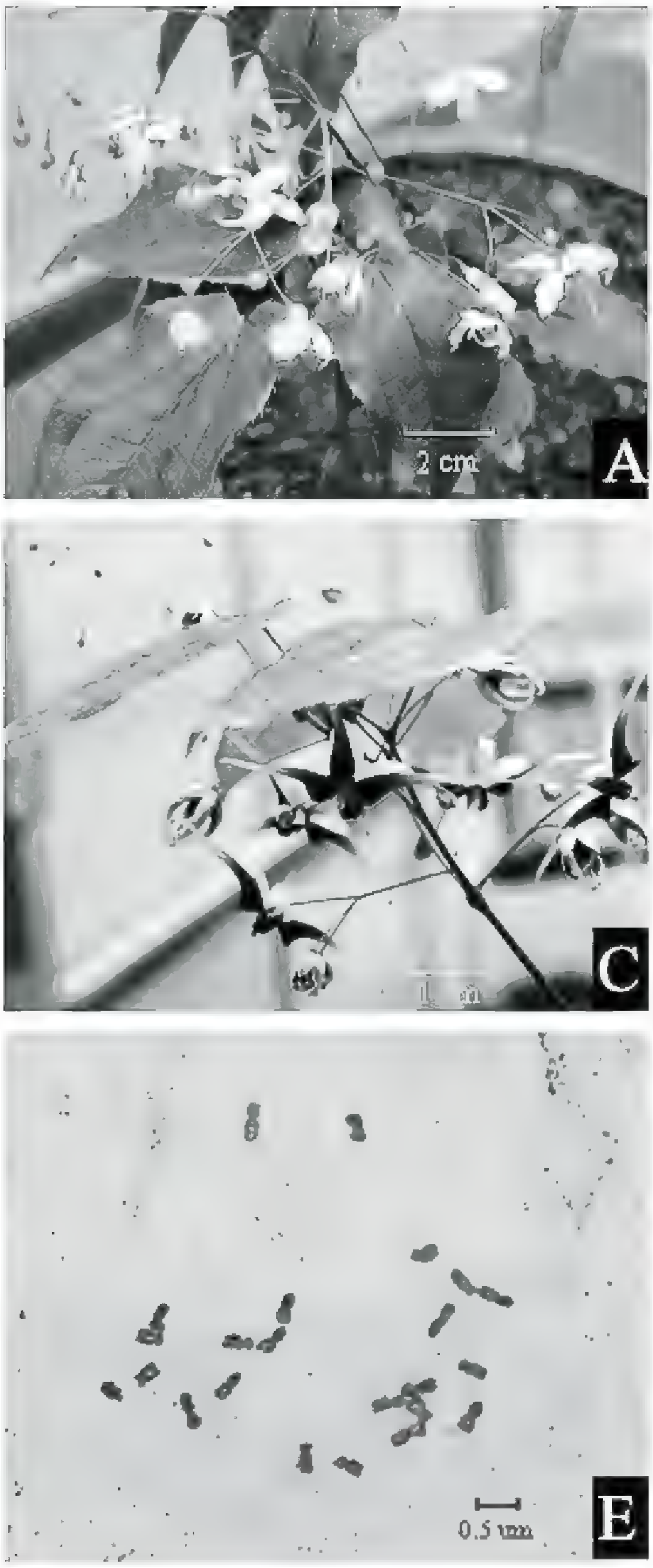

Figure 2. —A, B. Fertile plants of *Epimedium yinjiangense* M. Y. Sheng & X. J. Tian cultivated at the Institute of Plant Genetics and Breeding, Guizhou Normal University. —C, D. Flowers of *E. acuminatum* Franch., photographed in a greenhouse of the Institute. —E. Chromatids of *E. yinjiangense* stained with Giemsa stain, indicating $4n = 24$. —F. Chromatids of *E. acuminatum*, indicating $2n = 12$.

Relationships. *Epimedium yingjiangense* is similar to *E. acuminatum* Franch. (Fig. 2C, D) in that both taxa are tall perennial herbs with tubercular rhizomes, with basal and cauline trifoliolate leaves, large leaflets and flowers, a panicle with many flowers, two sepal whorls, and spurred petals. The new species clearly differs from *E. acuminatum* in its thick, fleshy leaflets glabrous on both surfaces, the white inner sepals with corrugate margins, and the glabrous peduncles. The leaflets of *E. acuminatum* are leathery with short hairs on the abaxial surface, the inner sepals are light pink with smooth margins, and the peduncles are covered with long pubescent hairs.

Cytological observations of *Epimedium yinjiangense*, with karyotypes sampled from root tips (Fig. 2E), indicate that *E. yinjiangense* is tetraploid ($4n =$

24). This differs from previous reports for other species in *Epimedium*, all of which have been diploids, with $2n = 12$ (*E. perralderianum* Coss., *E. sempervirens* Nakai ex F. Maek. [Tanaka & Takahashi, 1981]; *E. acuminatum*, *E. alpinum* L., *E. diphyllum* Lodd., *E. grandiflorum* C. Morren, *E. koreanum* Nakai, *E. leptorrhizum* Stearn, *E. myrianthum* Stearn, *E. pubigerum* C. Morren & Decne., *E. sagittatum* (Siebold & Zucc.) Maxim., *E. sempervirens*, *E. trifoliolatobinatum* (Koidz.) Koidz. [Takahashi, 1989]; *E. acuminatum*, *E. alpinum*, *E. borealiguizhouense* S. Z. He & Y. K. Yang, *E. davidi* Franch., *E. franchetii* Stearn, *E. myrianthum*, *E. pubigerum*, *E. sagittatum*, *E. simplicifolium* T. S. Ying, *E. sutchuenense* Franch., *E. wushanense* T. S. Ying [Sheng & Chen, 2007a, 2007b, 2008]; *E. brevicornu* Maxim., *E. enshiense* B. L. Guo & P. G. Xiao, *E. flavum* Stearn, *E. franchetii*, *E. ilicifolium* Stearn, *E. leptorrhizum* Stearn, *E. mikinorii* Stearn, *E. myrianthum*, *E. platypetalum* K. I. Mey., *E. pseudowushanense* B. L. Guo, *E. pubescens* Maxim., *E. sagittatum*, *E. sagittatum* var. *glabratum* T. S. Ying, *E. sutchuenense*, *E. wushanense*, *E. zhushanense* K. F. Wu & S. X. Qian [Zhang et al., 2008]).

Stearn (2002) established the most comprehensive classification system of *Epimedium*. In his monograph, he arranged the genus into two subgenera, subgenus *Epimedium* and subgenus *Rhizophyllum* (Fisch. & C. A. Mey.) Stearn, based mainly on whether or not the flowering stem has leaves. Stearn divided the subgenus *Epimedium* into four sections, according to their geographic distribution and infrageneric relationships. Among these four sections, members of section *Diphyllon* were all endemic to China, and this section was further subdivided into four series: series *Campanulatae* Stearn, series *Davidianae* Stearn, series *Dolichocerae* Stearn, and series *Brachycerae* Stearn. These series were established on the basis of corolla characteristics such as petal type, the form and relative size of the inner sepals and petals, and flower dimensions. Referring to the classification scheme in Stearn (2002), *E. yinjiangense* is assigned to *Epimedium* sect. *Diphyllon* ser. *Dolichocerae*, which corresponds to the infrageneric assignment of the related *E. acuminatum*.

Paratypes. CHINA. **Guizhou:** Yinjiang, 1000 m, 9 May 2008, *M. Y. Sheng 20080509* (GNUG); Jiangkou, 1100 m, 10 May 2008, *M. Y. Sheng 20080510* (GNUG).

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A New Species of *Peperomia* (Piperaceae) from the Cauca Valley, Colombia

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Abstract. A new species of *Peperomia* Ruiz & Pav., *P. rivulamans* Silverst. (Piperacaeae), is described from the Cauca Valley, Colombia. The new species is saxicolous and inhabits forested creek banks. It differs from all other known peltate-leaved species of *Peperomia* in the following combination of characters: rhizome creeping, with internodes very short (less than 1 cm); petioles very long (to 22 cm); leaves ovate, white on abaxial surface; inflorescences simple (not paniculate) and axillary; floral bracts mucronate, butterfly-shaped, imbricate at their corners, forming a roof above the fertile rachis, with openings for the ovary and anthers, each opening surrounded by four bracts; ovary turbinate, stigma bifid, apical; and fruits sessile, subclavate, not rostrate. Based on its morphology, the new species is placed in *Peperomia* subg. *Tildenia* Miq., but a published study of chloroplast DNA has shown that subgenus *Tildenia* is polyphyletic.

Resumen. Una nueva especie de *Peperomia* Ruiz & Pav., *P. rivulamans* Silverst. (Piperaceae), se describe del valle geográfico del río Cauca, Colombia. Es saxícola, y se encuentra en bosque en las orillas de quebradas. Difiere de todas las otras especies conocidas de *Peperomia* que presentan hojas peltadas en la siguiente combinación de caracteres: rizoma rastrero, con entrenudos muy cortos (menos de 1 cm); pecíolos muy largos (hasta 22 cm); hojas ovadas, blancas en la superficie abaxial; inflorescencias simples (no paniculadas) y axilares; brácteas florales mucronadas, de forma de mariposa, traslapándose en sus ángulos, formando un techo sobre el raquis fértil, con aberturas para el ovario y las anteras, cada abertura rodeada por cuatro brácteas; ovario turbinado, estigma bífido, apical; y frutos sésiles, subclavados, no rostrados. Con base en su morfología, la nueva especie se coloca en *Peperomia* subg. *Tildenia* Miq., pero un estudio publicado de DNA de cloroplasto ha mostrado que el subgénero *Tildenia* es polifilética.

Key words: Cauca Valley, Colombia, IUCN Red List, *Peperomia*, Piperaceae.

Peperomia Ruiz & Pav. (Piperaceae) is one of the largest genera of angiosperms; Mathieu (2008) recognized 1613 species, of which 245 are known from Colombia. Many parts of Colombia (particularly the Pacific coastal region, which has a very high biodiversity) are not well known botanically, and many undescribed species of *Peperomia* are likely to occur there. Even regions such as the Cauca Valley, which has lower biodiversity than the Pacific region and has lost most of its forests, still harbor undescribed species of *Peperomia*. During fieldwork for the catalog of the remnant flora of the Cauca Valley, an undescribed species of *Peperomia* was encountered at the extreme northern end of the valley.

Peperomia rivulamans Silverst., sp. nov. TYPE: Colombia. Risaralda: Mpio. Pereira, Hacienda Alejandría, Km 7 Cerritos–La Virginia rd., N end of Cauca Valley, ca. 4°51′31″N, 75°52′55″W, ca. 950 m, 13 Oct. 2008, *P. A. Silverstone-Sopkin, H. Sanint & M. E. Cardona 10856* (holotype, CUVC 42381; isotype, COL). Figure 1.

Haec species ab omnibus aliis speciebus *Peperomiae* Ruiz & Pav. quae folia peltata habent rhizomatibus repentibus, internodiis multo brevioribus, petiolis longioribus, foliis ovatis abaxialiter albis, inflorescentiis simplicibus axillaribus, bracteis florum mucronatis papilioniformibus ad angulos imbricatis supra rhachim fertilem tectum quod super ovaria et antheras apertum est producentibus, ovario turbinato, stigmate bifido apicali, fructibus sessilibus subclavatis non rostratis distinguitur.

Saxicolous herb; rhizomes exposed, repent, glabrous, producing roots along entire lower surface, rhizome internodes < 1 cm. Leaves alternate, peltate; petioles 6.2–22 cm, inserted 1.5–2.4 cm from leaf base, glabrous, succulent, in life very pale whitish pink or mottled red-violet; blades 6–11.8 × 3.7–7.5 cm, subcoriaceous, in life adaxial surface green (sometimes with white veins), abaxial surface white, glabrous, ovate, base rounded, apex shallowly acuminate, tip obtuse to acute, margin entire, 7(or 8) major veins radiating from petiole insertion, with

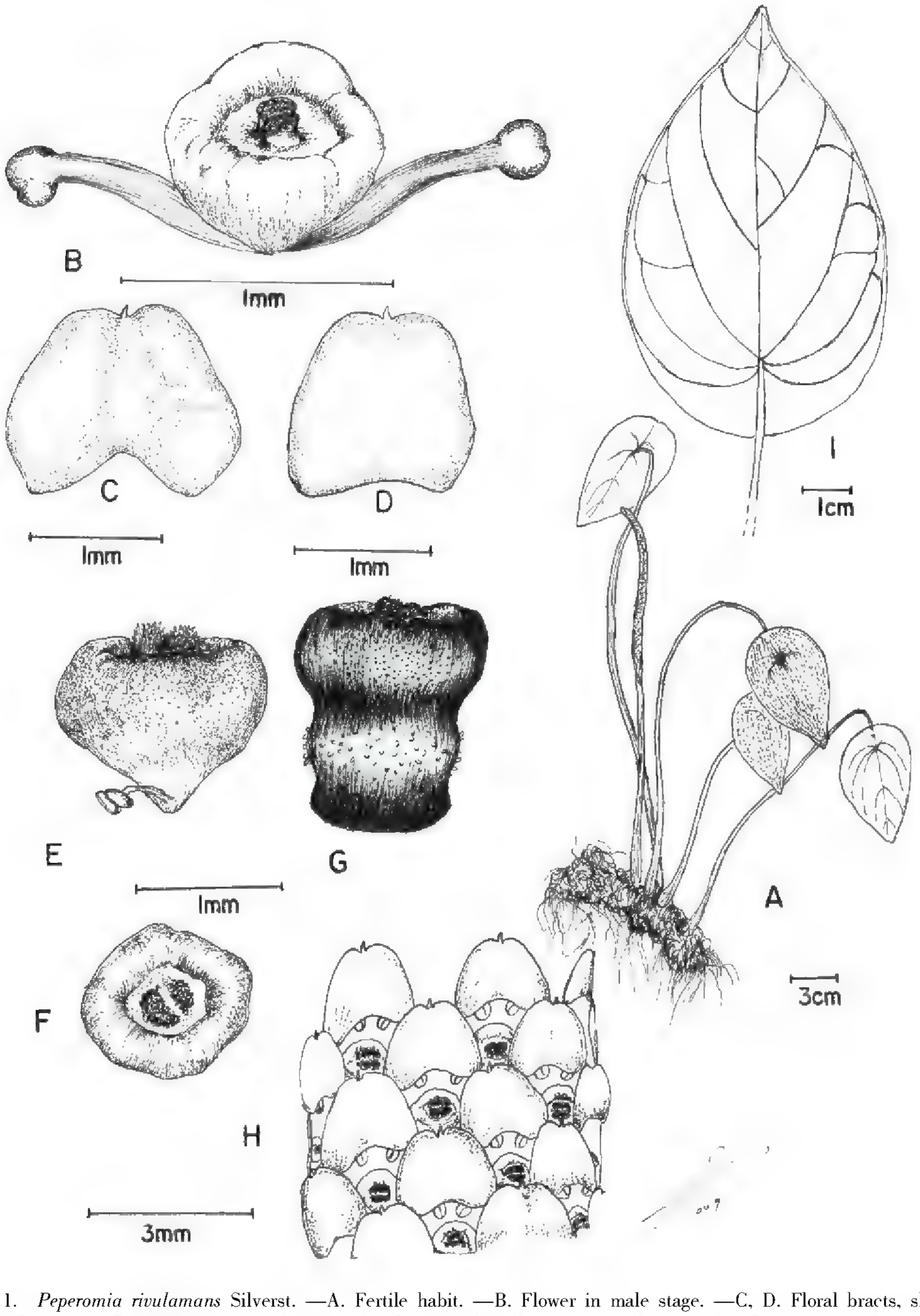

Figure 1. *Peperomia rivulamans* Silverst. —A. Fertile habit. —B. Flower in male stage. —C, D. Floral bracts, showing variation between inflorescences. —E. Flower in female stage, lateral view. —F. Flower in female stage, apical view. —G. Mature fruit. —H. Portion of inflorescence. —I. Leaf, abaxial view. A drawn from the paratype, *Silverstone-Sopkin et al. 10444* (CUVC); B, D from *D. Gamba s.n.* (inflorescence in alcohol only, 27 Feb. 2009, CUVC, not designated as paratype); C, E–I from the holotype, *Silverstone-Sopkin et al. 10856* (CUVC). All floral parts drawn from material in alcohol.

black (in dried material) punctate glands (most prominent in perimarginal zone of adaxial surface). Inflorescences produced in axils of new leaves, solitary, unbranched; peduncle 4–9.5 cm, glabrous, in life pink; rachis 5.4–13.7 × 0.5–0.6 cm; floral bracts in life greenish white, ca. 1.5 × 1.7 mm, glabrous, peltate, papilioniform (butterfly-shaped) but basal sinus sometimes shallow, apex emarginate and mucronate, overlapping at corners (2 anterior corners overlap above 2 adjacent distal bracts, 2 posterior

corners are overlapped by anterior corners of 2 adjacent proximal bracts), forming a roof over the fertile rachis, leaving openings that provide access to flowers, each opening surrounded by 4 adjacent bracts, in each opening 1 ovary and 2 anthers are exposed (these anthers are not from the same flower as the visible ovary, but from 2 adjacent distal flowers). Flowers adnate to distal side of stalk of floral bracts, protandrous, stamens 2, filaments well-developed, at male stage extended laterally, at female stage withdrawn to base of ovary, anthers ca. 0.3 × 0.2 mm; ovary turbinate, apex flattened and surrounded by raised rim, at male stage ca. 0.7 × 1 mm, at female stage ca. 1 × 1 mm (width at apex), stigma distinctly bifid, fimbriate, apical. Fruits ca. 1.5 × 1.2 mm, dark brown in alcohol (much darker than ovaries), sessile, subclavate, apex flattened (not rostrate) and surrounded by raised rim, constricted below apex, swollen at midlevel and bearing numerous tiny subulate glands, constricted again at base.

Note. At the Hacienda Riobamba, where one of the paratypes was collected, some individuals had white veins on the adaxial surface of the leaves; other syntopic individuals lacked white veins on the adaxial surface. At the type locality, all individuals had the adaxial surface of the leaves completely green. In both populations, the abaxial surface of all leaves was white.

Distribution, habitat, and ecology. *Peperomia rivulamans* is known from only two localities, at the northern end of the Cauca Valley. Its specialized habitat restricts its potential distribution. It probably occurred formerly in suitable habitats in other parts of the Cauca Valley and the adjacent piedmont, but most of this region has been deforested; only small fragments of forest remain, and most of these do not contain a stream. The type locality is a gallery forest surrounded by low hills covered with cattle pasture. This is not a true gallery forest; the entire region was covered with forest before 1915, and this forest was spared because the steep banks were not suitable for cattle (Hilda Sanint, pers. comm.). Through this forest passes the Quebrada Alejandría, a shallow, slow-flowing creek with many large rocks. *Peperomia rivulamans* is found at several sites in this forest, creeping over large rocks adjacent to the creek. *Dicranopygium callithrix* Silverst. (Cyclanthaceae) and a fern, *Thelypteris angustifolia* (Willd.) Proctor (Thelypteridaceae), are abundant in and adjacent to this creek. The vegetation here belongs to the tropical dry forest formation (Holdridge, 1967), but the microclimate within the gallery forest allows the presence of some plants typical of more humid formations, such as the tree fern *Cyathea pungens* (Willd.) Domin (Cyatheaceae) and *Blakea rosea* (Ruiz & Pav.) D. Don (Melastomataceae). The habitat of the paratype from the Hacienda Riobamba also is the bank of a shallow creek within tropical dry forest.

IUCN Red List category. *Peperomia rivulamans* is evaluated here as Critically Endangered (CR B2; D) according to IUCN Red List criteria (IUCN, 2001). Fewer than 30 individuals were seen at the two known localities; all plants were within 1.5 m from the edge of the creek.

Phenology. *Peperomia rivulamans* has been found with flowers in February and September, and with flowers and fruits in October.

Etymology. The specific epithet refers to the habitat (brooklet-loving).

Discussion. Dahlstedt (1900) divided the genus *Peperomia* into nine subgenera. Most of these subgenera were based on the morphology of the fruits, but *Peperomia* subg. *Tildenia* Miq. included the species with peltate leaves. Trelease and Yuncker (1950), in their revision of the Piperaceae of northern South America, did not mention Dahlstedt's subgenera, but their primary key to *Peperomia* separates the species into eight groups, some of which correspond to some of Dahlstedt's subgenera. Their group VII includes the species with peltate leaves; this group includes part of Dahlstedt's subgenus *Tildenia*.

Based solely on morphology, *Peperomia rivulamans* would be placed in subgenus *Tildenia* (group VII of Trelease & Yuncker, 1950) because of its peltate leaves. Wanke et al. (2006), however, found that subgenus *Tildenia* is polyphyletic. They compared the *trnK/matK* region of chloroplast DNA of 48 species of *Peperomia* from eight of Dahlstedt's nine subgenera. Their results indicated that only one of the subgenera (*Micropiper* Dahlst.) is monophyletic. The species of subgenus *Tildenia* that were studied fall into three different clades (designated as C, E, and G). As there is no information available on the DNA of *P. rivulamans*, it is not possible to assign this species to any of Wanke's clades.

Morphologically, *Peperomia rivulamans* differs from most of the described peltate-leaved species of *Peperomia* in its combination of creeping habit, very short internodes (< 1 cm long), glabrous leaves with a white abaxial surface, unbranched inflorescence, and subclavate nonrostrate fruit with an apical bifid stigma. It resembles *P. lanceolatopeltata* C. DC., which has short internodes and similarly shaped leaves, but the latter differs in having the petiole insertion closer to the basal margin of the blade (0.5 cm vs. 1.5–2.4 cm in *P. rivulamans*), leaves villous

on both sides (vs. glabrous), and fruits globose-ovoid with a suboblique apex and slightly subapical stigma (vs. subclavate fruits with a flattened apex surrounded by a raised rim, and apical stigma). *Peperomia rivulamans* also resembles *P. villibacca* Yunck., which has a creeping habit, very short internodes, glabrous leaves that are white on the abaxial surface, and an apical stigma. *Peperomia villibacca* differs from *P. rivulamans* in having shorter petioles (< 10 cm long vs. 6.2–22 cm in *P. rivulamans*), a rounded leaf apex (vs. shallowly acuminate), shorter inflorescences (4–5 cm vs. 5.4–13.7 cm), circular floral bracts (vs. papilioniform), and white-villous fruits (vs. glabrous fruits).

Paratypes. COLOMBIA. **Risaralda:** Mpio. Pereira, Hac. Alejandría, Km 7 Cerritos La Virginia rd., northern end of Cauca Valley, ca. 4°51′31″N, 75°52′55″W, ca. 950 m, 17 Oct. 2005, *P. A. Silverstone-Sopkin, H. Sanint & M. E. Cardona 10444* (CUVC, HUA). **Valle del Cauca:** Mpio. La Victoria, Hac. Riobamba, base of piedmont of western slope of Cordillera Central, 4°26′24″N, 75°54′01″W, 1082 m, 15 Sep. 2010, *P. A. Silverstone-Sopkin, G. A. Reina-Rodríguez & M. E. Cardona 11179* (CUVC).

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Alpinia oui (Zingiberaceae), a New Species from Taiwan

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Abstract. *Alpinia oui* Y. H. Tseng & Chih C. Wang, a new species of Zingiberaceae from southeastern Taiwan, is described and illustrated. This new species belongs to subgenus *Alpinia* Roxb. sect. *Alpinia* subsect. *Catimbium* (Horan.) R. M. Sm. It resembles *A. zerumbet* (Pers.) B. L. Burtt & R. M. Sm. in the shape and size of the flowers, but differs in the denser inflorescences and the dense brown pubescence of the capsules. According to the IUCN Red List Categories and Criteria, this species is assessed as Vulnerable (VU D1), because its wild populations number less than 1000 individuals and are so far known from only one locality in southeastern Taiwan.

Key words: *Alpinia*, IUCN Red List, Taiwan, Zingiberaceae.

The genus *Alpinia* Roxb. (Zingiberaceae) comprises 230 species that are mainly distributed in the subtropical and tropical rainforests of Asia, Australia, and the Pacific Islands (Wu & Larsen, 2000); 51 species have been found in China (Wu & Larsen, 2000). Thirteen taxa of *Alpinia* were previously recognized in the *Flora of Taiwan* (Moo, 1978); more recently, 14 taxa were recognized in the second edition of the *Flora of Taiwan* (Wang, 2000). Since then two new species, *A. nantoensis* F. Y. Lu & Y. W. Kuo and *A.* ×*ilanensis* S. C. Liu & J. C. Wang, and one confirmed species, *A. koshunensis* Hayata, have been reported (Kuo et al., 2008; Liu & Wang, 2009; Tseng et al., 2010). During a recent revision of the genus in Taiwan, an unusual species was discovered. Consultation of recent works on *Alpinia* (Yang & Wang, 1998; Kuo et al., 2008; Liu & Wang, 2009; Liu et al., 2009; Tseng et al., 2010) and relevant literature from neighboring regions (Wu & Larsen, 2000; Kress et al., 2005; Chaveerach et al., 2008) support its recognition as a new species.

Alpinia oui Y. H. Tseng & Chih C. Wang, sp. nov. TYPE: Taiwan. Taitung Co., Taimali township, Yaoshan, at forest margin, along semi-shaded trail, ca. 550 m, 11 Apr. 2008, *Yen-Hsueh Tseng 4204* (holotype, TCF; isotype, HAST). Figure 1.

Haec species *Alpiniae zerumbet* (Pers.) B. L. Burtt & R. M. Sm. affinis, sed ab ea foliis abaxialiter pubescentibus, inflorescentia thyrsiformi densiore ramis inferioribus brevioribus, labello ad basim albo apicem versus luteo rubrovittato atque infructescentia capusulisque dense pubescentibus distinguitur.

Herb 2–3 m tall. Leaves with the petiole lacking or to 1 cm; blades oblong to oblong-lanceolate, 30–60 × 7–15 cm, apex acuminate to obtuse, base cuneate, glabrous on adaxial surface, pubescent on abaxial surface, margins hirsute, midrib tomentulose abaxially; ligule ca. 1 cm, entire or bilobed, membranous, outer surface and margin tomentose. Inflorescence a terminal pendulous thyrse, 15–30 cm, the peduncle puberulent; lower branches ca. 0.5 cm, with 1 or 2 flowers, upper branches with 1 flower; bracts 1 or 2, deciduous. Flowers pedicellate on upper branches; bracteole pinkish white, 1–1.5 cm, glabrous except apically pubescent, deciduous; calyx tubular, pinkish white, pubescent, ca. 1.5 cm, shallowly 3-lobed, deeply split unilaterally; corolla white, glabrous, sympetalous, 3-lobed, the dorsal lobe oblong, ca. 4 × 2 cm, lateral lobes 2, basally 1/3 connate, oblong, ca. 3 × 1.2 cm; labellum ca. 3.5 × 2.5 cm, convolute, white toward base, yellow with red stripes toward apex with a blotch of red in between; staminodes obtuse, inconspicuous; stamen 1, anther ca. 1 cm, filament ca. 1.5 cm; stigma expanded, pubescent, style slender, ca. 3 cm, glabrous; epigynous glands 2, at style base, brown, ca. 2 mm; ovary green, densely pubescent. Infructescences densely pubescent, with the lower pedicels 0.5–1 cm; fruit capsular, red at maturity, ridged, densely brown pubescent, ellipsoid; seeds 15 to 30, angled; aril white, membranous.

Distribution and habitat. *Alpinia oui* is endemic to Yaoshan, Taimali township, Taitung County, Taiwan, and is found along semi-shaded forest margins at elevations of 500–600 m.

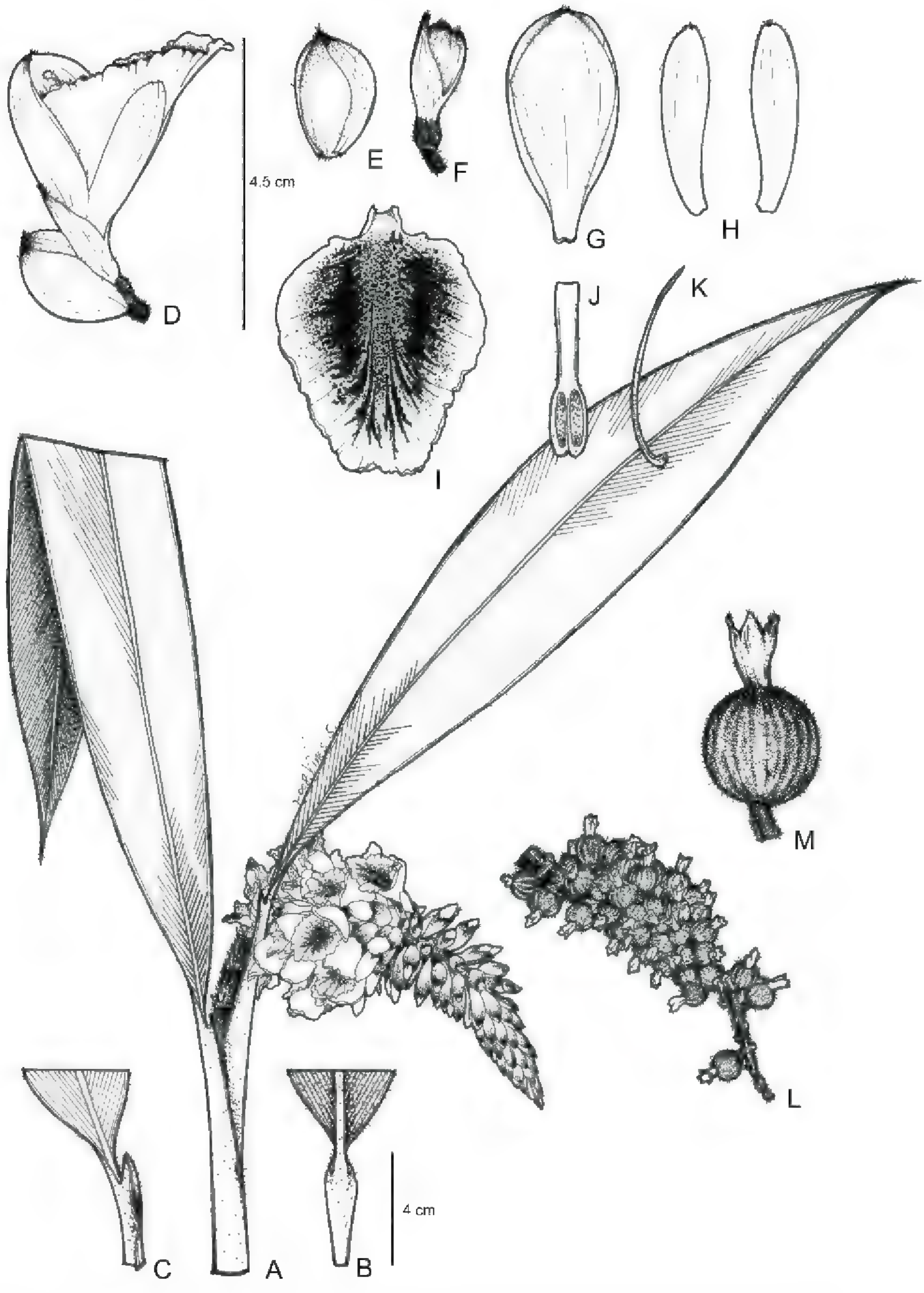

Figure 1. *Alpinia oui* Y. H. Tseng & Chih C. Wang. —A. Flowering pseudostem. —B. Leaf sheath, abaxial view. —C. Leaf sheath, lateral view. —D. Flower, lateral view. —E. Bracteole. —F. Flower petals, pistil, and stamens removed to show calyx tube. —G. Dorsal lobe of corolla. —H. Lateral lobes of corolla. —I. Labellum. —J. Stamen. —K. Style and stigma. —L. Infructescence. —M. Individual capsule, showing the villous pubescence. A–M drawn from the type *Tseng 4204*.

IUCN Red List category. According to IUCN Red List criteria (IUCN, 2008), *Alpinia oui* is treated here as Vulnerable (VU D1), with D1 indicating that the wild populations are small, with less than 1000 individuals, and are so far known from only one locality from southeastern Taiwan.

Phenology. Flowers of the new species were collected from April to June.

Table 1. Comparison of diagnostic characters of *Alpinia oui* and related species.

	A. oui	*A. zerumbet*	*A. shimadae* var. *kawakamii*
Leaf texture	herbaceous	herbaceous	herbaceous
Leaf adaxial surface	glabrous	glabrous	glabrous
Leaf abaxial surface	pubescent	glabrous	densely pubescent
Inflorescence	thyrse pendulous, densely flowered	thyrse pendulous, sparsely flowered	spike, erect
Labellum	white toward base, yellow with red stripes toward apex with a blotch of red in between	yellow with red stripes toward apex	white with red stripes toward apex
Length of infructescence pedicels	0.5–1 cm	1.5–2.5 cm	0.1–0.5 cm
Capsules	pubescent	sparsely hairy	pubescent

Etymology. The specific epithet honors Chern-Hsiung Ou, the mentor of the authors, of the Department of Forestry, National Chung Hsing University, for his contributions to the plant taxonomy and dendrology of Taiwan.

Discussion. *Alpinia oui* closely resembles *A. zerumbet* (Pers.) B. L. Burtt & R. M. Sm., but it is distinct in having denser thyrses; the labellum of the flower white toward the base, yellow with red stripes toward the apex with a blotch of red in between (vs. the labellum yellow with red stripes toward the apex in *A. zerumbet*); the lower infructescence pedicels ranging from 0.5–1 cm (vs. longer, 1.5–2.5 cm); and densely pubescent capsules (vs. sparsely hairy capsules). The two species occupy different ecological niches. *Alpinia oui* is a rare species restricted to semi-shaded forest margins at altitudes of ca. 550 m in southeastern Taiwan. *Alpinia zerumbet*, on the other hand, is more widespread in Taiwan, ranging from semi-shaded forest margins to fully exposed grasslands, and has been collected from sea level to 1500 m in elevation. *Alpinia oui* is also very similar to *A. shimadae* Hayata var. *kawakamii* (Hayata) Jeng J. Yang & J. C. Wang, but it can be distinguished by having pendulous inflorescences (vs. erect in *A. shimadae* var. *kawakamii*); different coloration and patterning of the labellum (white toward the base, yellow with red stripes toward the apex with a blotch of red in between vs. white with red stripes toward the apex); and infructescence pedicels 0.5–1 cm (vs. shorter, 0.1–0.5 cm). Diagnostic characters of the three species are compared in Table 1.

In this paper, 18 taxa of *Alpinia* are recognized in Taiwan and are included in the following key. All of these belong to *Alpinia* subg. *Alpinia* sect. *Alpinia*, but range among the four subsections: *Presleia* (Valeton) R. M. Sm., *Alpinia*, *Catimbium* (Horan.) R. M. Sm., and *Cenolophon* (Blume) R. M. Sm. We classify the new species *A. oui* in subsection *Catimbium* because of its large bracts that completely enclose the flower, its large buds and flowers, and the thyrse inflorescences.

KEY TO SPECIES OF *ALPINIA* IN TAIWAN

1. Inflorescences pendulous 2
1′. Inflorescences erect 3
2. Thyrses densely flowered; labellum white toward the base, yellow with red stripes toward the apex with a blotch of red in between; infructescences densely pubescent; lower pedicels 0.5 1 cm; capsules densely pubescent..... ..... *A. oui* Y. H. Tseng & Chih C. Wang
2′. Thyrses sparsely flowered; labellum yellow with red stripes toward the apex; infructescences sparsely hairy to glabrous; lower pedicels 1.5 2.5 cm; capsules sparsely hairy..... ..... *A. zerumbet* (Pers.) B. L. Burtt & R. M. Sm.
3. Inflorescences curved and ascending 4
3′. Inflorescences not curved and ascending 5
4. Labellum white-yellow with red stripes .... *A. mesanthera* Hayata
4′. Labellum deep yellow with red stripes..... ..... *A. tonrokuensis* Hayata
5. Inflorescences branched, usually with 2 or 3 ascending lateral axes; the labellum smaller than corolla lobes ..... *A. flabellata* Ridl.
5′. Inflorescences unbranched, only a single central axis; labellum larger than corolla lobes 6
6. Labellum deeply bilobed at apex; corolla lobes revolute ..... *A. galanga* (L.) Willd.
6′. Labellum entire or slightly bilobed at apex; corolla lobes not revolute 7
7. Labellum spread completely at anthesis 8
7′. Labellum not spread completely at anthesis 9
8. Labellum white-yellow, with red stripes; capsules conical, with rims ..... *A. formosana* K. Schum.
8′. Labellum white, with red stripes; capsules globose, without rims ..... *A. intermedia* Gagnep.
9. Labellum yellow, with red stripes 10
9′. Labellum white, with red stripes 12
10. Labellum milky yellow with red stripes; fruits pubescent, repressed globose, red at maturity.. ..... *A. kusshakuensis* Hayata
10′. Labellum deep yellow, with red stripes 11
11. Fertile peduncle, rachis, and pedicel pubescent; pedicels 0.2 0.5 cm; fruit pubescent, without ridges, orange at maturity ..... *A. uraiensis* Hayata

11′. Fertile peduncle, rachis, and pedicel glabrous; pedicels 1 2 cm; fruit glabrous, ridged, red at maturity ..... *A. koshunensis* Hayata
12. Bracteole absent 13
12′. Bracteole present 14
13. Leaves glabrous on both surfaces, except on margins and the lower midrib; mature fruits with many rims, sparsely hairy .... *A. pricei* Hayata var. *pricei*
13′. Leaves glabrous on adaxial surface, densely pubescent abaxially; mature fruits with 1 or 2 rims, pubescent..... *A. shimadae* var. *kawakamii* (Hayata) Jeng J. Yang & J. C. Wang
14. Bracteole small, < 0.5 cm, inconspicuous, deciduous; ovary visible and conspicuous 15
14′. Bracteole conspicuous, > 1 cm, persistent or deciduous; ovary concealed by bracteole 16
15. Labellum with the apex 2-lobed or emarginate, 1 1.2×0.9 1.1 cm, with red stripes extending to labellar margin ..... *A. japonica* (Thunb.) Miq.
15′. Labellum apex emarginate or rounded, 1.4 1.8× 1.2 1.5 cm, with red stripes not reaching the labellar margins..... ..... *A. ×ilanensis* S. C. Liu & J. C. Wang
16. Bracteole tuberous, usually present on the calyx tube of mature fruits .... *A. nantoensis* F. Y. Lu & Y. W. Kuo
16′. Bracteole not tuberous 17
17. Bracteole length longer than calyx, persistent on mature infructescences ..... *A. pricei* var. *sessiliflora* (Kitam.) Jeng J. Yang & J. C. Wang
17′. Bracteole length shorter than calyx, most deciduous at anthesis, with a few persistent on mature infructescences .... *A. shimadae* Hayata var. *shimadae*

Paratypes. TAIWAN. **Taitung Co.:** Taimali Township, Yaoshan, en route on semi-shaded forest margins, 25 Apr. 2008, *Yen-Hsueh Tseng 4208* (TCF), 6 July 2008, *Chih-Chiang Wang s.n.* (TCF).

Acknowledgments. The authors thank Ching-I Peng, director of HAST herbarium, Biodiversity Research Center, Academia Sinica; Jenn-Che Wang, Department of Life Science, National Taiwan Normal University; and Fu-Yuan Lu, Department of Forestry, National Chaiyi University for their useful suggestions. We also thank Sao-Mei Houng for the illustration.

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Quercus delgadoana (Fagaceae), a New Species from the Sierra Madre Oriental, Mexico

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ABSTRACT. *Quercus delgadoana* S. Valencia, Nixon & L. M. Kelly (Fagaceae), a new species from the states of Hidalgo, Puebla, and Veracruz in the Sierra Madre Oriental, Mexico, is described and illustrated. We discuss its morphological similarity to *Q. eugeniifolia* Liebm., *Q. sapotifolia* Liebm., *Q. salicifolia* Née, *Q. laurina* Bonpl., and *Q. affinis* Scheidw., with which it shares narrowly lanceolate leaves and fasciculate stipitate trichomes in the axils of the secondary veins on the underside of the lamina. A dichotomous key is provided to distinguish these species.

RESUMEN. Se describe e ilustra *Quercus delgadoana* S. Valencia, Nixon & L. M. Kelly (Fagaceae), una especie nueva de los estados de Hidalgo, Puebla y Veracruz en la Sierra Madre Oriental, México. Se discute su similitud morfológica con *Q. eugeniifolia* Liebm., *Q. sapotifolia* Liebm., *Q. salicifolia* Née, *Q. laurina* Bonpl. y *Q. affinis* Scheidw., con las que comparte la forma lanceolada de las hojas y la presencia de tricomas fasciculados estipitados en las axilas de las venas secundarias en el envés. Se presenta una clave dicotómica para su identificación.

Key words: Fagaceae, IUCN Red List, Mexico, *Quercus*, Sierra Madre Oriental.

A review of herbarium specimens for the genus *Quercus* L. (Fagaceae), particularly for red oaks in section *Lobatae* Loudon, led to the discovery of an undescribed oak species. The new species grows in the Sierra Madre Oriental, in the states of Hidalgo, Puebla, and Veracruz. Based on the narrow, lanceolate, glabrate leaves, specimens of the new species had often been misidentified as other species, including *Q. eugeniifolia* Liebm., which has a known range restricted to Central America (Costa Rica and Panama); *Q. salicifolia* Née, endemic to the Sierra Madre del Sur; *Q. sapotifolia* Liebm. from Central America and the Sierra Madre Oriental in Mexico; and even *Q. laurina* Bonpl. from the Sierra Madre del Sur and the Trans-Mexican Volcanic Belt or *Q. affinis* Scheidw. distributed along the Sierra Madre Oriental and to the east of the Trans-Mexican Volcanic Belt. We visited populations of *Q. delgadoana* S. Valencia, Nixon & L. M. Kelly in the field and compared this species with the type specimens and photographs, topotypes, and original descriptions of *Q. eugeniifolia*, *Q. salicifolia*, *Q. sapotifolia*, *Q. laurina*, and *Q. affinis* (Née, 1801; Humboldt & Bonpland, 1809; Scheidweiler, 1837; Liebmann, 1854). This revealed the characters that uniquely differentiate *Q. delgadoana*, and a dichotomous key is provided to distinguish these six similar species.

KEY FOR SIX *QUERCUS* SPECIES IN MEXICO AND CENTRAL AMERICA

1a. Fruits with annual maturation.
  2a. Abaxial leaf surface glabrous or sometimes with some stellate trichomes at the base; secondary veins 12 to 15 on each side ..... *Q. eugeniifolia*
2b. Abaxial leaf surface with some glandular trichomes and with fasciculate trichomes in the secondary vein axils; secondary veins 10 to 14 on each side.
  3a. Acorns pubescent; leaves lanceolate or elliptic; secondary veins nearly flat on the abaxial leaf surface; apex acute; endemic to the Pacific slope of the Sierra Madre del Sur ..... *Q. salicifolia*
  3b. Acorns glabrate; leaves oblanceolate to obovate or elliptic; secondary veins slightly impressed on the abaxial leaf surface; apex obtuse to rounded; south-

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eastern Mexico and Central America ..... *Q. sapotifolia*

1b. Fruits with biennial maturation.
  4a. Secondary veins 14 to 20 on each side, impressed on the adaxial leaf surface; blade margin revolute; adaxial leaf surface without stellate trichomes ..... *Q. delgadoana*
  4b. Secondary veins 5 to 10 on each side, nearly flat or slightly raised on the adaxial leaf surface; blade margin not revolute; adaxial leaf surface with some stellate trichomes toward the base.
    5a. Buds ovoid to globose; abaxial leaf surface with some glandular trichomes; altitudinal range 1600 3650 m; Sierra Madre del Sur and the Trans-Mexican Volcanic Belt ..... *Q. laurina*
    5b. Buds conical; abaxial leaf surface without glandular trichomes; altitudinal range 1200 2800 m; Sierra Madre Oriental and to the east of the Trans-Mexican Volcanic Belt ..... *Q. affinis*

Quercus delgadoana S. Valencia, Nixon & L. M. Kelly, sp. nov. TYPE: Mexico. Hidalgo: Mpio. Tlanchinol, Km 165 de la carr. Tlanchinol–Tampico, ca. 5 km al sur de la desviación de Lontla, 21°00′N, 98°39′W, 1540 m, 23 Oct. 2008, *S. Valencia A., A. Coombes & K. Vega 3748* (holotype, FCME; isotypes, BH, HUAP, K, MEXU, MO, NY). Figure 1.

Haec species inter congeneros *Querci* L. sect. *Lobatarum* Loudon foliis angustis lanceolatis glabratis praeditos quoad fructus maturationem biennem *Querco affini* Scheidw. et *Q. laurinae* Bonpl. simillima, sed ab eis lamina foliari venis secondariis 14- ad 20-jugatis adaxialiter impressis, margine revoluta atque trichomatibus stellatis adaxialiter carente distinguitur.

Trees to 25 m high, trunk 0.5–1.2 m diam.; branchlets (1.8–)2–3(–4) mm thick, glabrous, lenticels inconspicuous; buds (0.6–)1–4 × (0.7–)1–2.5 mm, conical, glabrous, bud scales ovate or long ovate, with ciliate margin; stipules deciduous before the leaves fully develop. Mature leaves with petioles 2–6 × 1.1–1.8 mm, glabrous, dark toward the base; blades coriaceous, glaucous, narrowly oblong, elliptic, or lanceolate, 7–18.5 × 1.5–4(–5.4) cm; base cuneate or rounded; margin entire, slightly thickened and revolute; blade apex acute, to acuminate and aristate; secondary veins (9 to)14 to 20 on each side, parallel, straight or slightly curved upward, branched and anastomosing near the margin; adaxial leaf surface glabrous, secondary veins impressed, sometimes almost inconspicuous; abaxial leaf surface slightly paler than adaxial leaf surface, usually glabrous, sometimes with tufts of fasciculate stipitate trichomes in the axils of secondary veins, epidermis slightly papillose, middle and secondary veins slightly raised, tertiary veins flat or slightly raised. Pistillate catkins axillary; pistillate flowers on a short stalk 1.5–8 mm, with 1 or 2 distal flowers; perianth free, forming a flange. Staminate catkins not seen. Fruit biennial, solitary or in pairs at the end of a glabrous peduncle 5.5–17 × 1.6–4.5 mm; cupule obconic to slightly turbinate, 6–15 × 3–8 mm, margin not inrolled; scales ovate, canescent basally, the margins ± glabrous; acorn ovoid, with tomentose endocarp and glabrous exocarp, 18.3–22.9 × 10.8–13 mm.

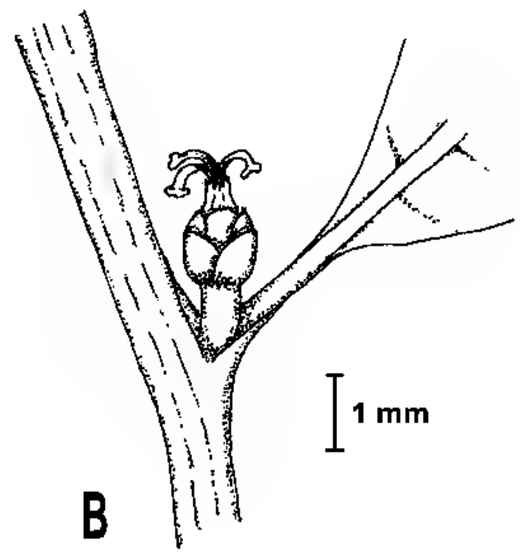
Distribution, habitat, and phenology. *Quercus delgadoana* is endemic to the Sierra Madre Oriental, Mexico, with populations in the states of Hidalgo, Puebla, and Veracruz. The new species has been collected in montane cloud forest and humid forests of *Quercus* at altitudes of 1400–2210 m. It is commonly found with *Fagus grandifolia* Ehrh. subsp. *mexicana* (Martínez) E. Murray, *Q. affinis*, *Q. lancifolia* Shltdl. & Cham., *Alnus jorullensis* Kunth, *Liquidambar styraciflua* L., and occasionally with *Q. corrugata* Hook., *Q. cortesii* Liebm., and *Q. hirtifolia* M. L. Vázquez, S. Valencia & Nixon. Flowers may be produced in March, but only pistillate flowers were observed; fruits can be found in October and November.

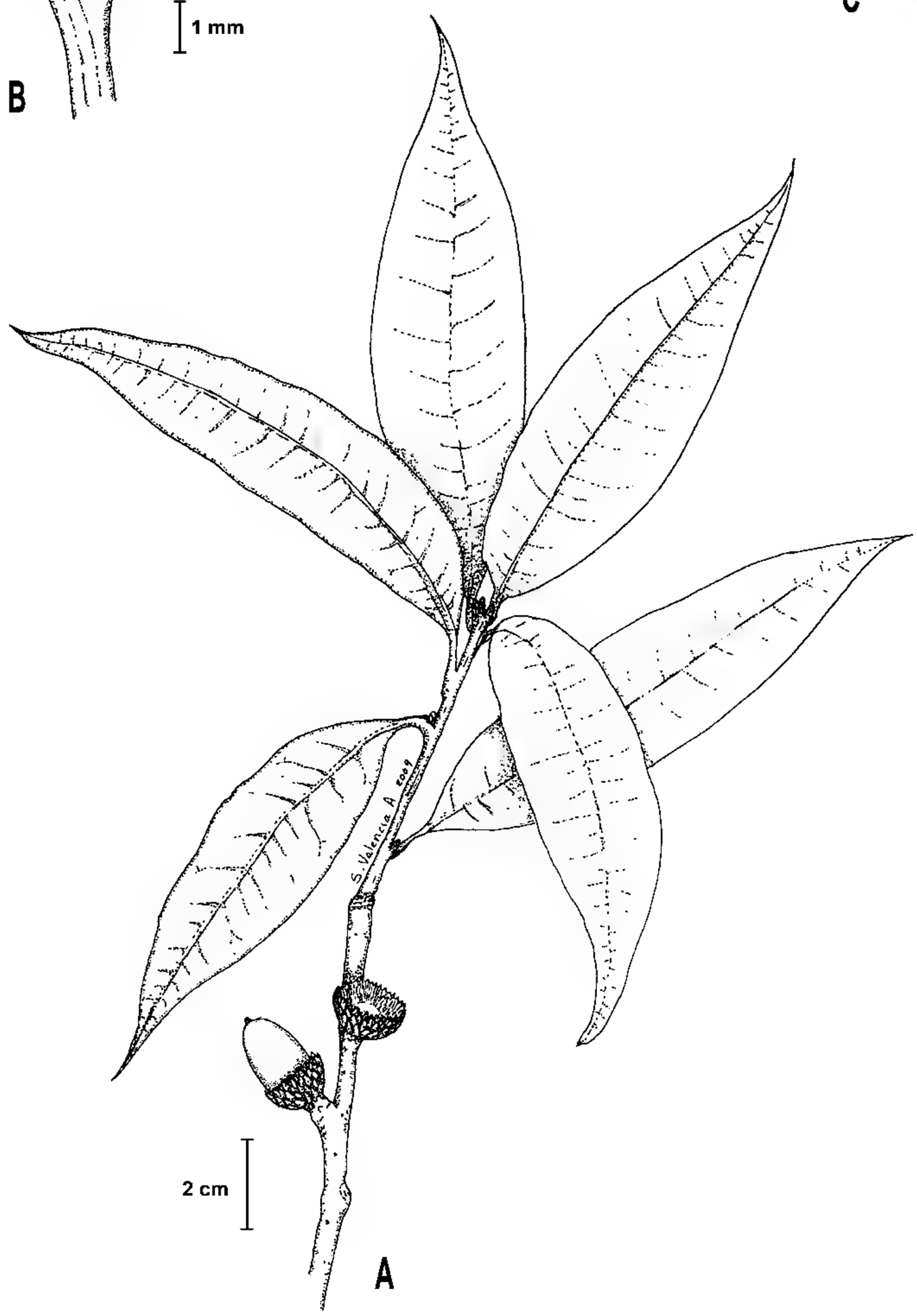
IUCN Red List category. According to IUCN Red List criteria (IUCN, 2001), *Quercus delgadoana* is here given a preliminary classification of Endangered (EN). This species grows in the humid forests of eastern Mexico, in cloud forest communities that are highly disturbed due to the extraction of firewood, the establishment of coffee plantations, and the clearance of forest for pasture. A decline in its populations of more than 50% is projected to take place as a result of losses to suitable habitat that have already been sustained, as well as potential future loss of habitat.

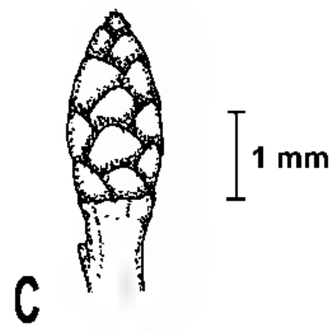
Etymology. *Quercus delgadoana* is named in honor of Alfonso Delgado Salinas (Instituto de Biología, UNAM), in recognition of his diverse contributions to plant taxonomy and the training and motivation he has given to so many students in this area of study.

Relationships. The aristate leaf apices, the pistillate flowers with a free perianth forming a skirt or flange, and the tomentose endocarp of the acorn support the assignment of *Quercus delgadoana* to *Quercus* sect. *Lobatae* (sensu Nixon, 1993).

The most important character that differentiates *Quercus delgadoana* from *Q. eugeniifolia*, *Q. salicifolia*, and *Q. sapotifolia* is that the latter three have fruits that mature annually, while fruits of *Q. delgadoana* mature biennially. However, in *Q. delgadoana*, this character is sometimes masked







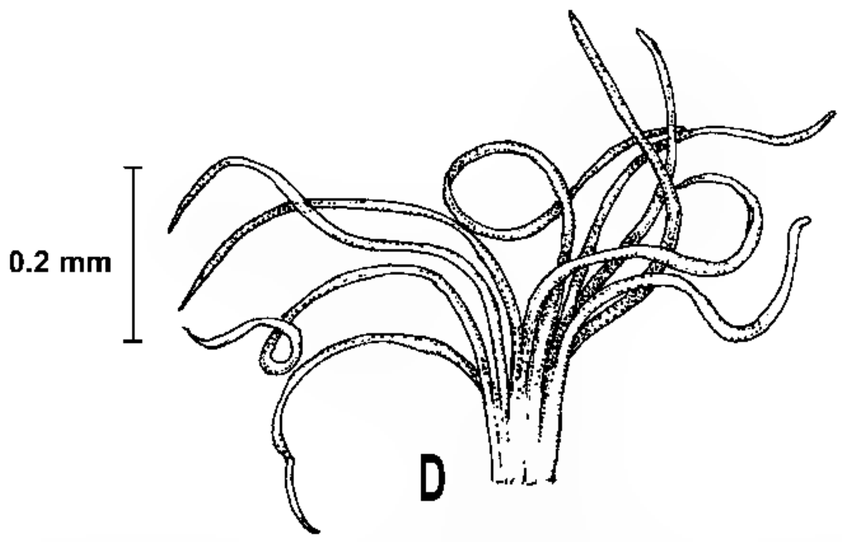


Figure 1. *Quercus delgadoana* S. Valencia, Nixon & L. M. Kelly. —A. Branchlet with leaves and fruit. —B. Pistillate flower. —C. Terminal bud. —D. A fasciculate trichome from one of the secondary vein axils. Drawn from the holotype *S. Valencia A., A. Coombes y K. Vega 3748* (FCME).

because new leaves, shoots, and flowers do not develop every year. Because the fruits take two years to mature and are presented on the terminal twigs, this may give the false impression of annual maturation. Fruits with biennial maturation were observed in the field in two populations of *Q. delgadoana* found in Xochicoatlán and near Tlanchinol, both in the state of Hidalgo.

Additionally, the entire and revolute leaf margins, the parallel secondary veins, and the lack of glandular trichomes on the abaxial leaf surface distinguish *Quercus delgadoana* from *Q. salicifolia*. *Quercus sapotifolia* can be distinguished by the broadly or narrowly rounded and aristate leaf apex and the smaller acorn to 15 × 7 mm. The new species further differs from *Q. laurina* and *Q. affinis* in the impressed secondary veins on the adaxial leaf surface, with 14 to 20 veins on each side (vs. these veins not impressed and 5 to 9 veins per side in *Q. affinis* and 6 to 10 veins on each side in *Q. laurina*), the revolute leaf margins (vs. leaf margins not revolute), and the lack of stellate trichomes on the adaxial leaf surface (vs. adaxial leaf surface with some stellate trichomes toward the base).

Paratypes. MEXICO. **Hidalgo:** Mpio. Lolotla, a 1.84 km SE de Tenango, 20°51′23″N, 98°41′55″W, 15 Apr. 2001, *A. Ponce V. 74* (FCME); a 2.82 km SO de Chalma, 20°51′5″N, 98°40′52″W, 26 Oct. 2001, *A. Ponce V. 207* (FCME); Mpio. Tenango de Doria, Agua Fría, aprox. 500 m E de El Damo, 20°19′27″N, 98°12′44″W, 29 Oct. 1993, *O. Alcantara A. 1542* (FCME, MEXU); Agua Fría, aprox. 2.5 km E de El Damo, 20°19′43″N, 98°11′54″W, 27 Oct. 1993, *O. Alcantara A. 1509, 1517* (FCME); El Damo, aprox. 1 km E, camino Tenango de Doria San Nicolás, 20°19′59″N, 98°12′49″W, 27 June 1993, *O. Alcantara A. & E. Ortiz B. 1140, 1142* (FCME); El Damo, 2 km SE de Tenango de Doria, 20°19′39″N, 98°12′37″W, 12 Mar. 1993, *I. Luna V., S. Ocegueda C. & O. Alcantara A. 912* (FCME); El Cirio, aprox. 1.2 km O de San Nicolás, 20°19′19″N, 98°12′6″W, 5 Sep. 1993, *I. Luna V., S. Ocegueda C. & O. Alcantara A. 1465* (FCME); 6 km NE de Agua Zarca, 20°18′55″N, 98°14′23″W, 21 Oct. 2008, *S. Valencia A., A. Coombes & Karla Vega 3722* (FCME, HUAP); Mpio. Tlanchinol, camino a Coatlán, 21°00′N, 98°30′W, 6 June 1993, *I. Luna, S. Ocegueda, O. Alcantara 793* (FCME); camino Tlanchinol Coatlán, 20°58′39″N, 98°36′56″W, 8 Oct. 1992, *I. Luna V., S. Ocegueda C. & O. Alcántara A. 680* (FCME, MEXU), *688* (FCME), *I. Luna V. & O. Alcantara A. 691* (FCME); 5 km al E de Tlanchinol, 20°58′59″N, 98°36′56″W, 14 Sep. 1991, *I. Luna V. 45* (FCME); camino a Lontla, 7 km al N de Tlanchinol, 21°2′53″N, 98°39′14″W, 24 ago. 1997, *Alcantara A. & R. Mayorga S. 3355* (FCME); Km 165 de la carr. Tlanchinol Tampico, aprox. 5 km S de la desviación de Lontla, 21°00′N, 98°39′W, 1540 m, 23 Oct. 2008, *S. Valencia A., A. Coombes & K. Vega 3747, 3749* (BH, FCME, HUAP); Mpio. Tlahuelompa, aprox. 1 km E sobre la desviación a Tlahuelompa, 20°37′51″N, 98°36′47″W, 22 Oct. 2008, *S. Valencia A., A. Coombes & K. Vega 3741* (FCME, HUAP); Mpio. Xochicoatlán, alrededores de Xochicoatlán, 29 June 1997, *S. Valencia A. 1341, 1342, 1343, 1344, 1345, 1346, 1347, 1348, 1349, 1350, 1351, 1353, 1354, 1355, 1356* (FCME), 29 June 1997, *S. Valencia A. 1352* (FCME, MO). **Puebla:** Mpio. Zacatlán, Jilotzingo, 29 Jan. 1991, *Martínez Murillo Ma. E. 93, 99, 112* (FCME, MEXU); Xilocuautla, *F. Miranda 3128* (MEXU); Mpio. Hueytamalco, 7 km N of Teziutlan on hwy. from Teziutlan to Tlapacoyan, 19°52′22″N, 97°10′14″W, 16 Oct. 2000, *L. Kelly & K. C. Nixon 1090, 1091* (MEXU); N of Hueytamalco, 3 km S of Cruz Verde, Km 12 along hwy. from Teziutlan to Tlapacoyan, 19°53′203″N, 97°17′871″W, 30 Sep. 2000, *L. Kelly & K. C. Nixon 1054* (MEXU). **Veracruz:** Mpio. Acajete, ca. 4 km E of Acajete, 3 km above (S of) Plan de Sedeño, 5 km S of hwy. betw. Perote & Xalapa, 16 Oct. 2000, *L. Kelly & K. C. Nixon 1105* (MEXU).

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Scheidweiler, M. 1837. Chenes de Mexicque. Hort. Belge 4: 321.

A New Species of *Memecylon* (Melastomataceae) from Taiwan

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ABSTRACT. *Memecylon pendulum* Chih C. Wang, Y. H. Tseng, Y. T. Chen & Kun C. Chang, a new species of Melastomataceae from Taiwan, is described and illustrated. This new species is allied to *M. lanceolatum* Blanco but is clearly distinguished by its pendulous branchlets, smaller leaves to 7 cm long, shallowly 4-lobed calyx, obtuse or rounded apices of flower buds, and yellowish green fruit at maturity.

Key words: IUCN Red List, Melastomataceae, *Memecylon*, Taiwan.

The genus *Memecylon* L. (Melastomataceae) consists of about 150 species, mainly in the Old World tropics (Mabberley, 1987; Chen & Renner, 2007). There are 11 species of *Memecylon* in China (Chen, 1984), and in Taiwan the genus has been represented by only one species, *M. lanceolatum* Blanco (Chang, 1977; Huang & Huang, 1993). During a field trip along a stream in central Taiwan in June 2005, an interesting new species of *Memecylon* was collected, which clearly differed from previously described species of the genus (Clarke, 1879; Gamble, 1919; Bremer, 1979; Murugan et al., 2000).

Memecylon pendulum Chih C. Wang, Y. H. Tseng, Y. T. Chen & Kun C. Chang, sp. nov. TYPE: Taiwan. Taichung Co.: Taipen township, Huangchikeng, along stream, 24°04′196″N, 120°47′138″E, ca. 265 m, 1 June 2005 (fl.), *Chih-Chiang Wang 1601* (holotype, TCF; isotype, MO). Figure 1.

Haec species *Memecyloni lanceolato* Blanco affinis, sed ab eo ramis pendulis, foliis minoribus (2.5–7 × 1.5–2.5 cm), calycibus non profunde 4-lobatis, alabastro apice obtuso vel rotundato et fructibus maturis flavo-viridibus differt.

Large shrubs or small trees, 3–6 m high; bark grayish, shallowly fissured; branches terete, glabrous; branchlets pendulous, twigs with acute angles. Leaves opposite, glabrous on both surfaces, 2.5–7 × 1.5–2.5 cm, elliptic, cuneate to attenuate at base, entire, acute or acuminate at apex; veins pinnate, midrib impressed adaxially and slightly raised abaxially, lateral veins 4 to 7 per side, coriaceous, drying dull greenish yellow; petioles 3–5 mm, channeled adaxially. Inflorescences axillary cymose; peduncle 3–7 mm, 4-angled; pedicels 2–3 mm, slender; bracts 0.5–0.8 mm. Flower buds obtuse or rounded at apex with the petals exposed; expanded flowers 5–6 mm wide; calyx purple, campanulate, 1.8–2 mm wide, shallowly 4-lobed; petals 4, white, blue at base, broadly elliptic to obovate, to 2 × 2.5 mm, shortly clawed at base, acute or apiculate at apex; disc striate; stamens 8, equal; filaments slender, to 4 mm; anthers ca. 2 mm, the connective with a gland; style subulate, 3.5–4 mm; stigma simple. Fruit globose, 7–8 mm diam., crowned by a persistent calyx, the fruit usually yellowish green when mature; seed 1, ca. 6 mm diam.

Distribution and habitat. *Memecylon pendulum* is known only from only two localities in Taichung County in central Taiwan. The two sites were located on hilly slopes at altitudes of 265 m and ca. 320 m.

IUCN Red List category. *Memecylon pendulum* is known only from Taichung County in central Taiwan. Our field observations suggest that this species is uncommon, and the population size is estimated to number fewer than 250 mature individuals. We assess a preliminary conservation status of Endangered (EN), according to IUCN Red List criteria (IUCN, 2001).

Phenology. Flowering in the new species was observed in June, and fruits were collected in December.

Etymology. The specific epithet refers to the pendulous branchlets of the new species.

Discussion. *Memecylon pendulum* is closely allied to *M. lanceolatum* Blanco. The new species is clearly distinguished by its pendulous branchlets, smaller leaves (2.5–7 × 1.5–2.5 cm), the shallowly 4-lobed calyx, flower buds with obtuse to rounded apices, and the yellowish green mature fruits. *Memecylon lanceo-*

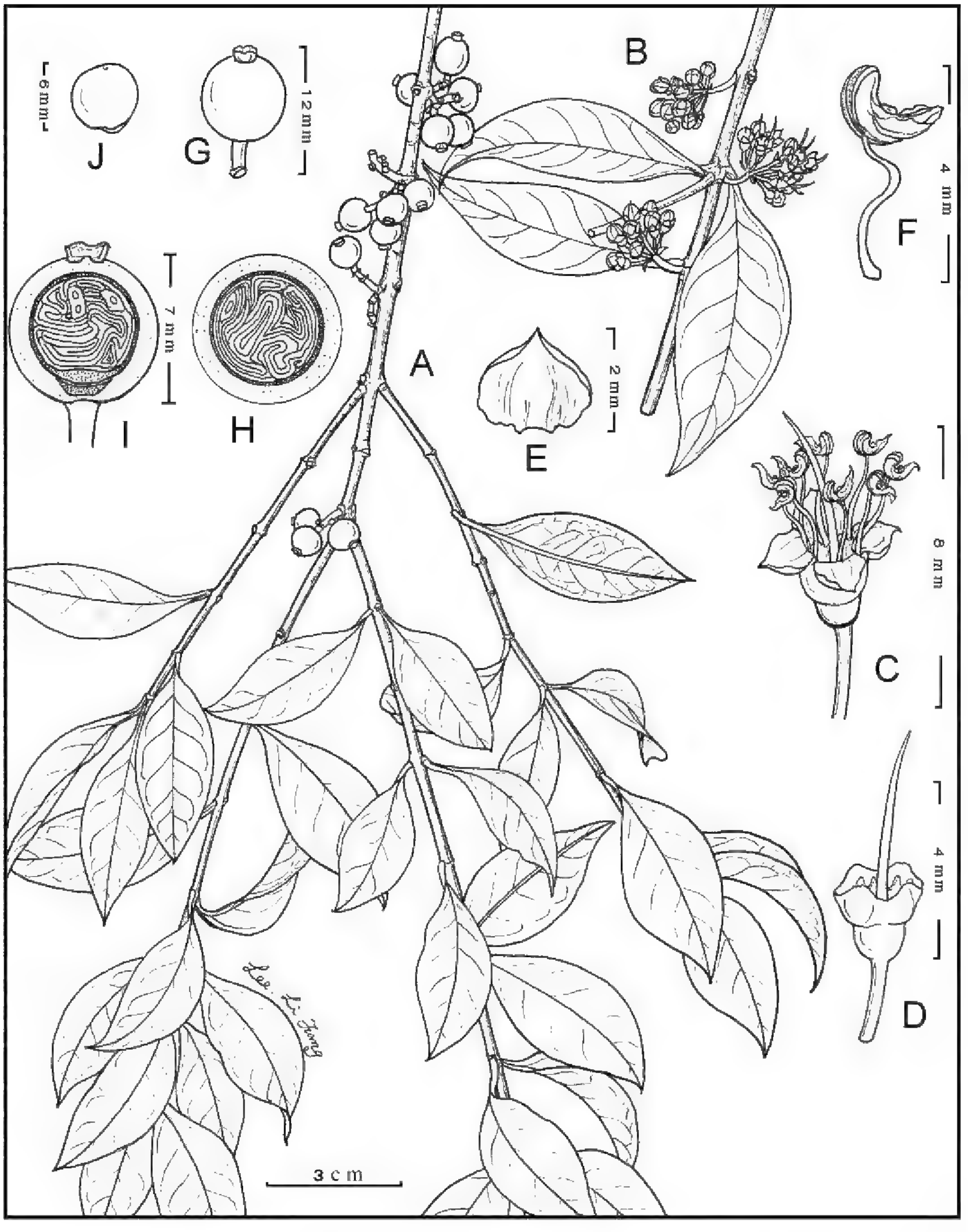

Figure 1. *Memecylon pendulum* Chih C. Wang, Y. H. Tseng, Y. T. Chen & Kun C. Chang. —A. Habit. —B. Flower buds. —C. Flower. —D. Calyx cup with the style visible. —E. Petal. —F. Stamen, lateral view. —G. Fruit. —H. Cross section of fruit. —I. Longitudinal section of fruit. —J. Seed. Drawn from the holotype *Chih-Chiang Wang 1601* (TCF).

latum has ascending branchlets, larger leaves (7–9 × 2.3–3.5 cm), a truncate calyx, flower buds with acute apices, and purple to black-purple to black mature fruits. Concerning the distribution range, *M. lanceolatum* has a broader distribution, ranging from the Philippines to Borneo, Celebes, and Taiwan. In Taiwan, the taxon is confined to the island of Lanyu (Huang & Huang, 1993). This contrasts with the endemic distribution of *M. pendulum*, which is known only from central Taiwan.

Paratypes. TAIWAN. **Taichung Co.:** Wufung township, Ishenteng, hilly slope, ca. 320 m, 4 Dec. 2006 (fr.), *Chih-Chiang Wang 1720* (TCF).

Acknowledgments. The authors thank Chern-Hsiung Ou, Department of Forestry, National Chung Hsing University, and Fu-Yen Lu, Department of Forestry, National Chaiyi University, for their useful suggestions, encouragement, confirmation of the novelty of the taxon, and assistance with the Latin diagnosis. We also thank Li-fang Lee for the illustration.

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Elatostema recurviramum (Urticaceae), a New Cave-dwelling Species from Guangxi, China

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Abstract. A new species, *Elatostema recurviramum* W. T. Wang & Y. G. Wei (Urticaceae), from Guangxi, China, is described and illustrated, and its affinities are discussed. It most closely resembles *E. cyrtandrifolium* (Zoll. & Moritzi) Miq., from which it differs in the recurved stems and branches, the denticulate margin of the leaf apex, the larger, ovate stipules, the presence of densely distributed cystoliths on the blade midrib, and the glabrous, lineolate achenes. The new taxon was collected from a limestone cave and is considered to be Critically Endangered (CR) according to IUCN Red List criteria.

Key words: China, *Elatostema*, Guangxi, IUCN Red List, Urticaceae.

There are more than 350 species of *Elatostema* J. R. Forst. & G. Forst. (Urticaceae) in the world. A great number of species are distributed in tropical and subtropical Asia and Africa (Wang, 1995), and more than 146 of these occur in China (Lin & Duan, 2008). This genus was established in 1775, belongs to tribe Elatostemeae of Urticaceae, and is most closely related to *Pilea* Lindl. However, the two genera can be easily distinguished by certain characteristics, for example, differences in the pistillate reproductive organs and staminate cymes. There are three tepals on the pistillate flower in species of *Elatostema*; these are very small (shorter than the ovary) or completely degenerated, and its achene has a longitudinal rib. The cymes of most species in *Elatostema*, with few exceptions, are not normally branched. The fertile axis and branches are extremely shortened, with an inconspicuous form and the receptacle visible. At the same time, the bracts of the *Elatostema* cyme form an involucrum around the receptacle (Wang, 1980a, 1980b). Weddell (1869) described about 48 species of *Elatostema* in his book on the Urticaceae and divided these into two sections: section *Androsyce* Wedd. and section *Elatostema*. Wang (1980b) considered that *Elatostema* and *Pellionia* Gaudich. both evolved from the ancestral genus *Pilea*. An increasing number of new taxa of *Elatostema* have been found and described in recent years. These have included two new series, *Elatostema* ser. *Weddelia* W. T. Wang (Lin, 2008) and *Elatostema* ser. *Albopilosoides* Q. Lin & L. D. Duan (Lin & Duan, 2008); 22 species (Wang & Wei, 2007, 2008; Lin, 2008; Lin & Duan, 2008; Wei & Wang, 2009; Duan & Lin, 2010); three varieties (Wang & Wei, 2008; Wei & Wang, 2009); and one new name (Lin, 2008).

During a field trip to Bama County, Guangxi Province, in southwestern China in 2008, we collected several unknown species of Urticaceae. We noted all individuals with remarkable, recurved branches and eventually collected 12 specimens from different locations in one particular cave. Every specimen and all living plants in the cave were noted to have this particular branch characteristic. In total, we collected an additional six specimens at different times since 2008. After carefully observing their vegetable and reproductive organs, we confirmed that these specimens represent a new species of *Elatostema*, assigned to the genus based on the particular characteristics of their pistillate flowers, including the tepals of the pistillate flower and the achene; the collections were easily distinguished from the two similar genera *Pellionia* and *Pilea*. Based on the study of national floras (Wang, 1995; Lin et al., 2003) and relevant literature, the examination of a total of 105 specimens of the related *E. cyrtandrifolium* (Zoll. & Moritzi) Miq. in CDBI, HITBC, IBK, and PE, and comparison of approximately 140 species of *Elatostema* from Guangxi and adjacent Guangdong, Guizhou, and Yunnan provinces, we propose this taxon to be a new and undescribed species. The present work is based on herbarium material and living plants from IBK and from the greenhouse at the

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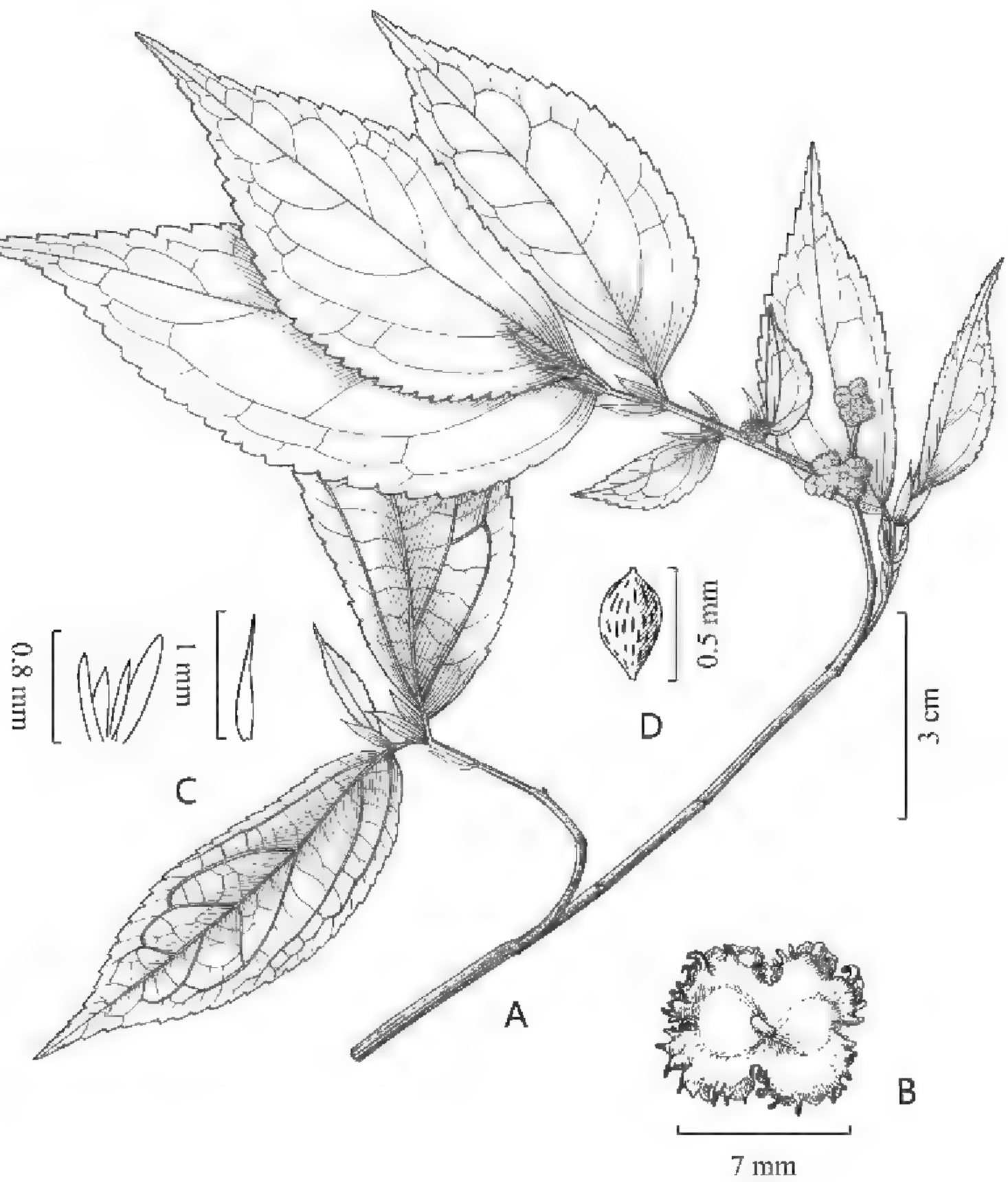

Figure 1. *Elatostema recurviramum* W. T. Wang & Y. G. Wei. —A. Upper portion of fertile stem. —B. Pistillate inflorescence (lower view). —C. Bracteoles. —D. Achene. Drawn by Ying-Bao Sun from the holotype, *Y. G. Wei 09135* (PE).

Institute of Botany of Guangxi. Conventional methods of herbarium taxonomy were used. We observed the structure of the capitula, flowers, and other organs with a stereoscopic zoom microscope (×200; Nikon Corporation, Tokyo, Japan).

Elatostema recurviramum W. T. Wang & Y. G. Wei, sp. nov. TYPE: China. Guangxi Prov.: Bama Co., Poyue Village, 300 m, 107°5′E, 24°8′N, 22 Apr. 2008, *Y. G. Wei 09135* (holotype, PE; isotype, IBK). Figure 1.

Haec species *Elatostemati cyrtandrifolio* (Zoll. & Moritzi) Miq. et *E. fengshanensi* W. T. Wang & Y. G. Wei affinis, sed a hoc lamina foliari adaxialiter sparse strigosa vel glabrescente, ab illo lamina foliari abaxialiter secus venas raro omnino sparse strigosa, bracteis apice corniculatis atque acheniis glabris lineolatis, ab ambobus caule et ramis apicem versus recurvatis, stipulis ovatis 7–10 × 3–4 mm ad costam cystolithis dense tecta, lamina foliari margine dentata, inflorescentia pistillata sessili capitata semper solitaria, ejus bracteis ca. 18 depresse deltatis 0.2–0.3 × 0.7–1 mm atque bracteolis linearibus oblanceolato-linearibus vel anguste ovatis 0.5–0.8 mm longis apice longe corniculatis glabris differt.

Perennial herb; rhizomatous, stems ca. 45 cm, ca. 3 mm diam. near the base, recurved toward the apex, with 4 recurved branches; branches 1.5–7.5 cm, glabrous; cystoliths densely distributed, ca. 0.2 mm. Leaves petiolate or subsessile, lamina chartaceous, weakly asymmetrical, elliptic, or oblong, (2–)4–9.5 × 1–3.5 cm, apex acuminate, base weakly asymmetrical, cuneate, margins dentate, adaxial leaf surface sparsely strigose to glabrescent, cystoliths punctiform or bacilliform, very sparse, abaxial surface sparsely strigose along veins, where present, restricted to the nerves, rarely covering the whole lamina, 0.1–0.15 mm, basal 3-nerved, secondary nerves in 3 or 4 pairs, flush with the adaxial surface of the lamina, prominulous or flush with the abaxial surface of the lamina; petioles 1–3 mm, glabrous; stipules 7–10 × 3–4 mm, ovate, glabrous, midrib with a dense covering of cystoliths, cystoliths 0.1–0.3 mm. Pistillate inflorescences ca. 6 to 10, solitary, axillary,

Table 1. Morphological comparison of *Elatostema recurviramum* with the related *E. cyrtandrifolium* and another typical troglophilic species, *E. fengshanense*.

	E. recurviramum	*E. cyrtandrifolium*	*E. fengshanense*
Stems	recurved toward the apex	ascending or erect	ascending
Branches	with 4 recurved branches	branched or rarely simple	simple
Stipules	ovate, 7–10 × 3–4 mm, midrib with dense covering of cystoliths	narrowly lanceolate or subulate, 3–5 × 0.5–1 mm, with cystoliths	narrowly ovate or lanceolate, ca. 7 × 2–2.6 mm, midrib green
Leaf laminae			
Shape	weakly asymmetrical, elliptic, or oblong	obliquely elliptic	obliquely narrowly elliptic or narrowly ovate
Size	(2–)4–9.5 × 1–3.5 cm	5–15 × 2.2–5 cm	(0.7–)3–10 × (0.5–)1.3–4 cm
Margins	dentate	sharply serrate	narrower side 5- to 11-serrate, broader side 5- to 14-serrate
Abaxial surface	sparsely strigose along veins, rarely covering the whole lamina	sparsely puberulent or glabrescent along veins	sparsely strigose
Adaxial surface	sparsely strigose to glabrescent, sparse cystoliths punctiform, bacilliform	sparsely strigillose, cystoliths slightly conspicuous, dense	glabrous
Pistillate inflorescence	solitary, capitate	solitary or in pairs	in pairs
Peduncle	sessile	sturdy, 0.5–2 mm	sturdy, ca. 0.5 mm
Receptacle	ca. 6.8 × 4.8 mm, oblong, green when fresh, glabrous	2–10 mm diam.	broadly oblong, ca. 2.6 × 2 mm, 2-lobed in the middle, glabrous
Bracts	depressed-deltate, 0.2–0.3 × 0.7–1 mm, ca. 18, apex 0.2–0.6 mm, corniculate	ovate or broadly ovate, ca. 0.25 mm long, ca. 5, sparsely pubescent	opposite pairs larger, flat, broadly ovate, 0.5–0.6 × 1–1.2 mm, apex 0.8–1 mm, corniculate; the 6 remaining pairs broadly ovate, 0.3–0.4 × ca. 0.6 mm, apex ca. 0.5 mm, corniculate, pubescent
Bracteoles	linear, oblanceolate-linear, or narrowly ovate, 0.5–0.8 mm, apex long corniculate, glabrous	spatulate or linear-lanceolate, ca. 0.8 mm, apical white hairs	broadly linear or spatulate, 0.3–0.5 mm, apex truncate, densely ciliate

sessile, capitate; receptacle ca. 6.8 × 4.8 mm, oblong, green when fresh, glabrous; bracts 0.2–0.3 × 0.7–1 mm, ca. 18, depressed-deltate, apex 0.2–0.6 mm, corniculate; bracteoles numerous per inflorescence, 0.5–0.8 mm, linear, oblanceolate-linear, or narrowly ovate, positioned on the receptacle, apex long corniculate, glabrous. Staminate inflorescences not seen. Achenes ca. 0.5 mm, brownish, elliptic, striped.

Distribution and habitat. *Elatostema recurviramum* is endemic to the type locality in Bama County, Guangxi Province, China, at an altitude of 300 m. We investigated other similar caves as well as suitable environments around this cave for a distance of ca. 1.5 km on six visits since 2008. The new species is commonly found at the type locality—a large limestone cave; however, we could not find any individuals outside the cave, even at a distance of only 5 m from the cave entrance. We therefore consider the new species to be a strict troglophile. The principal plant species accompanying the new taxon were *Chiritopsis repanda* W. T. Wang (Gesneriaceae), *E. coriaceifolium* W. T. Wang, and *Begonia bamaensis* Yan Liu & C. I Peng (Begoniaceae), which were also found in this cave at the type locality.

IUCN Red List category. *Elatostema recurviramum* is evaluated here as Critically Endangered (CR A2c) according to IUCN Red List criteria (IUCN, 2001), based on our investigation of the type locality. Many tourists visit this cave and they represent the main threat to this species.

Phenology. *Elatostema recurviramum* was observed in flower in April, according to information for the holotype and isotype, and as noted at the type locality for living, mature plants.

Discussion. *Elatostema recurviramum* most closely resembles *E. cyrtandrifolium* (Zoll. & Moritzi) Miq.

Elatostema fengshanense W. T. Wang & Y. G. Wei is another typical troglophile, which has been found only in four limestone caves in Fengshan County, near Bama County. However, the new species can be easily distinguished from both of these species by its stems and branches that are always apically recurved; the ovate stipules, 7–10 × 3–4 mm; the blade midribs that are densely covered by cystoliths; the dentate lamina margins; the sparsely strigose to glabrescent adaxial blade surface; the abaxial blade surface that is sparsely strigose along the veins, rarely covering the whole lamina; the pistillate inflorescence that is solitary, capitate, sessile, with no evident peduncle; ca. 18 depressed-deltate, pistillate bracts, 0.2–0.3 × 0.7–1 mm, with a corniculate apex, 0.2–0.6 mm; and the pistillate bracteoles that are linear, oblanceolate-linear, or narrowly ovate, 0.5–0.8 mm, with a long corniculate, glabrous apex. The three species are distinguished from each other in Table 1.

Acknowledgments. We thank Ying-Bao Sun for preparing the illustration of *Elatostema recurviramum*. This study was supported by the Guangxi Institute of Botany, Guangxi Zhuang Autonomous Region, and the Chinese Academy of Sciences.

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Two New Species of *Aristolochia* (Aristolochiaceae) from Hainan Island, China

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ABSTRACT. Two new species of *Aristolochia* (Aristolochiaceae), *A. ledongensis* Han Xu, Y. D. Li & H. J. Yang and *A. jianfenglingensis* Han Xu, Y. D. Li & H. Q. Chen, are described and illustrated from Hainan Island, China. *Aristolochia ledongensis* differs from the similar *A. championii* Merr. & Chun and *A. bambusifolia* C. F. Liang ex H. Q. Wen by having the exterior of the calyx yellow (vs. yellowish green), a smaller basal portion of the calyx tube (15–16 × 4.5–5 mm vs. 30–70 × 7–10 mm), a narrower calyx limb (0.5–0.7 cm vs. 1.5–6 cm wide), and a shorter peduncle (0.7–1 cm vs. 1.8–5 cm). *Aristolochia jianfenglingensis* differs from the similar *A. championii* and *A. bambusifolia* by having the stems glabrous (vs. densely villous), the exterior of the calyx light red-brown (vs. yellowish green), a smaller basal portion of the calyx tube (23–26 × 5–6 mm vs. 30–70 × 7–10 mm), and a narrower calyx limb (0.8–0.9 cm vs. 1.5–6 cm wide). *Aristolochia championii* and *A. bambusifolia* have densely villous stems; the exterior of the calyx is yellowish green, with a larger basal portion of the calyx tube (> 30 × ca. 10 mm); the calyx limb is discoid and more than 15 mm wide; and the peduncle is longer than 18 mm. Both new taxa are assessed as Vulnerable (VU D2) according to IUCN Red List criteria.

Key words: *Aristolochia*, Aristolochiaceae, China, Hainan, IUCN Red List.

Aristolochiaceae has about eight genera and an estimated 450 to 600 species that grow primarily in tropical and subtropical regions. A total of four genera (one endemic) and 86 species (69 endemic) are recorded from China. *Aristolochia* L. is the largest genus in the family, with about 400 species widely distributed in tropical, subtropical, and temperate regions of the Old World, including Australia. There are 45 species (33 endemic) in China, and five species of *Aristolochia* are known from Hainan Island. The two new species described here bring the species total from Hainan Island to seven. *Aristolochia* species are mainly twining climbers with woody or herbaceous stems, rarely erect shrubs or herbs, and the roots are often tuberous (Huang, 1987; Cheng et al., 1988; Huang et al., 2003).

1. Aristolochia ledongensis Han Xu, Y. D. Li & H. J. Yang, sp. nov. TYPE: China. Hainan: Jianfengling Natl. Nature Reserve, Ledong, 18°45′N, 108°58′E, 310 m, 20 Aug. 2008, *Han Xu & H. Q. Chen JFL00972* (holotype, CANT). Figure 1.

Species *Aristolochiae championii* Merr. & Chun et *A. bambusifoliae* C. F. Liang ex H. Q. Wen similis, sed ab eis calyce flavo tubo basali 15 16 × 4.5 5 mm, limbo perianthii 0.5 0.7 cm lato et pedunculo pendulo 0.7 1 cm longo differt.

Lianas; stems woody, terete, densely yellow-brown villous. Leaves with the petioles 0.5–1.1 cm, densely yellow-brown villous; leaf blades lanceolate or elliptic-lanceolate, 6.5–11 × 1.7–3.9 cm, leathery, abaxially densely yellow-brown villous, especially on midrib, adaxially with mixed tomentum of yellow-brown villous and white pubescence, veins pinnate, in 7 to 10 pairs, shortly yellow-brown villous; blade base shallowly cordate, sinus < 2–3 mm deep, apex acute. Flowers solitary; peduncles pendulous, 0.7–1 cm, yellow-brown villous; bracteoles ovate, ca. 0.6 × 1.3 mm, inserted at peduncle bases, inconspicuous. Calyx externally yellow, 3.1–3.7 cm; throat yellow with dark red-brown spots; calyx tube geniculate, externally densely yellow villous; basal portion of tube 15–16 × 4.5–5 mm; calyx limb yellow, 5–7 mm wide, margin not revolute, the lower lobe protuberant, adaxially densely papillate; stamens 6 in 1 series of 3

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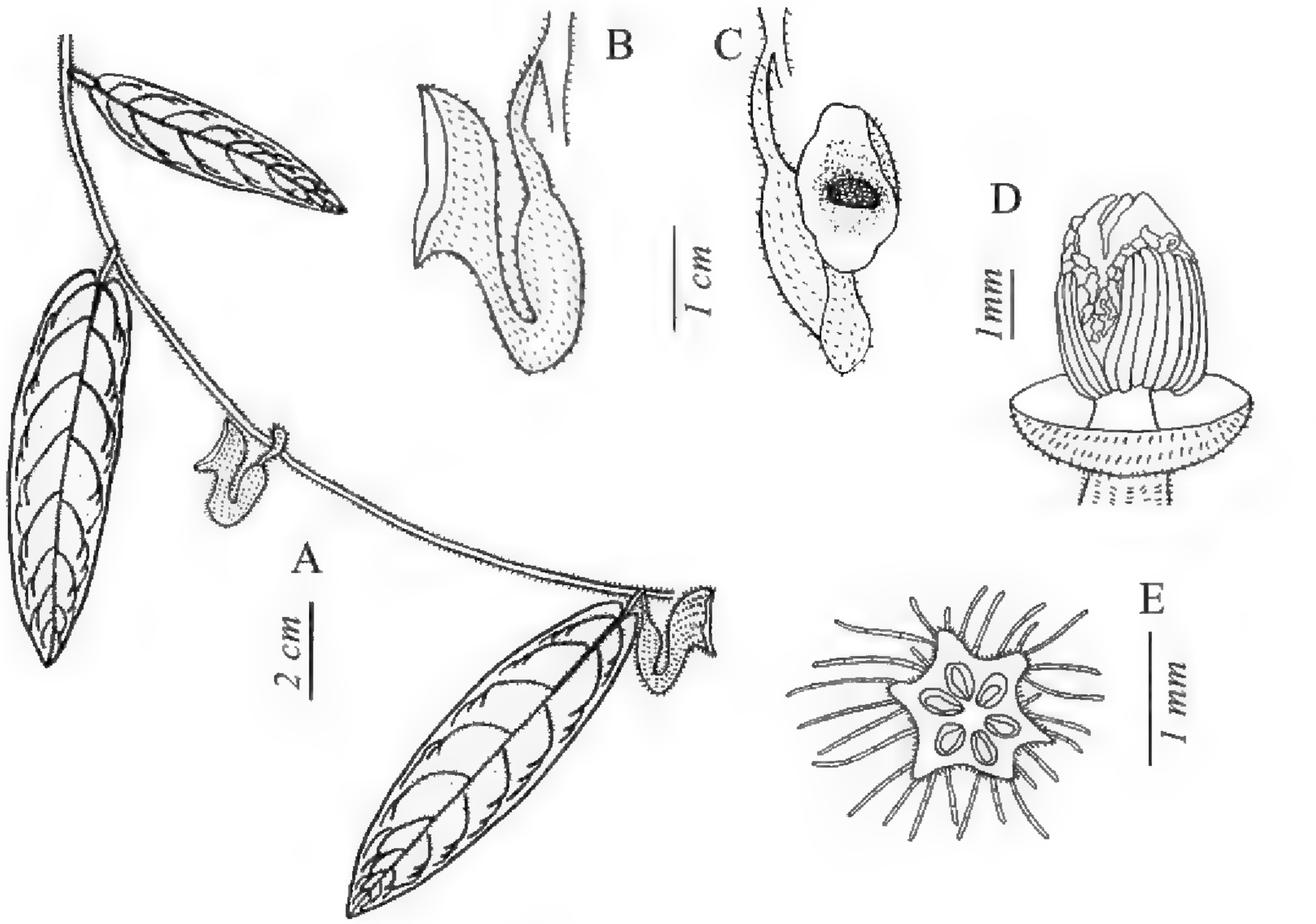

Figure 1. *Aristolochia ledongensis* Han Xu, Y. D. Li & H. J. Yang. —A. Flowering branch. —B. Lateral view of open flower. —C. Face view of open flower. —D. Gynostemium. —E. Transverse section of ovary. Drawn by S. L. Lu from the holotype *Han Xu & H. Q. Chen JFL00972* (CANT).

pairs; anthers oblong, ca. 2.1 mm, 2-loculed, dehiscence longitudinal; ovary 6-loculed, with long yellow-brown villous hairs; ovules numerous, usually in 1 series; placentation axile; gynostemium free, column 3-lobed, without protuberant apex. Capsule not seen.

Distribution and habitat. *Aristolochia ledongensis* is known from two populations found within the Jianfengling National Nature Reserve on Hainan Island. The type population was found under the canopy of tropical rainforest dominated by plant families including Dipterocarpaceae, Theaceae, Euphorbiaceae, and Myrtaceae at an altitude of 310 m, and the climate is tropical monsoon.

IUCN Red List category. Jianfengling is located in the southwest of Hainan Island. To date, 2817 plant species belonging to 1213 genera and 239 families have been reported from this 472-km^2 area (Zeng et al., 1995). Logging has been prohibited in this area since 1993, and the habitats are now protected. An area of 202 km^2 is designated as Jianfengling National Nature Reserve. Within this area, *Aristolochia ledongensis* is known from only two populations, with fewer than five individuals seen at each site. Therefore, the new species is assigned a preliminary status of Vulnerable (VU D2) according to IUCN Red List criteria (IUCN, 2001), indicating a population with a very restricted area of occupancy (typically less than 20 km^2) or number of locations (typically five or fewer).

Phenology. Flowering specimens of the new species were collected in August.

Etymology. The specific epithet is derived from the Chinese Pinyin name of the collection locality of the holotype, Ledong, referring to the name of the city.

Relationships. *Aristolochia ledongensis* is most similar to *A. championii* Merr. & Chun (distributed in Guangdong, Guangxi, Guizhou, and Sichuan provinces, China) and *A. bambusifolia* C. F. Liang ex H. Q. Wen (distributed in Guangxi Province, China). The new species differs by having the exterior of the calyx yellow (vs. yellowish green), the basal portion of the calyx tube smaller (15–16 × 4.5–5 mm vs. 30–70 × 7–10 mm), a narrower calyx limb (0.5–0.7 cm vs. 1.5–6 cm wide), and a shorter peduncle (0.7–1 cm vs. 1.8–5 cm). *Aristolochia ledongensis* is also similar to *A. fangchi* Y. C. Wu ex L. D. Chow &

S. M. Hwang and *A. petelotii* O. C. Schmidt, but differs by having a narrower leaf blade (1.7–3.9 cm vs. 3.5–8 cm wide), solitary flowers (vs. two to four and racemose), and a narrower calyx limb (0.5–0.7 cm vs. 4–7 cm wide).

Infragenera in *Aristolochia* include subgenus *Pararistolochia* (Hutch. & Dalziel) O. C. Schmidt, subgenus *Siphisia* (Raf.) Duch., and subgenus *Aristolochia* L.; recent treatments to sectional levels include Ma (1989) and González and Stevenson (2002). Only subgenus *Siphisia* and subgenus *Aristolochia* are distributed in China. Subgenus *Siphisia* is characterized by having more than three lobes of the gynostemium, a solitary anther on the outer surface of each gynostemium lobe, and a perianth with one to three lobes. Subgenus *Aristolochia* is characterized by having three lobes of the gynostemium, anthers paired on the outer surface of each gynostemium segment, and a perianth with three lobes. Based on these characters, the new species is placed in subgenus *Siphisia*.

Paratype. CHINA. **Hainan:** Jianfengling Natl. Nature Reserve, under tropical rainforest, 18°45′N, 108°58′E, 310 m, 20 Aug. 2008, *Han Xu & H. Q. Chen JFL00973* (IBSC).

2. Aristolochia jianfenglingensis Han Xu, Y. D. Li & H. Q. Chen, sp. nov. TYPE: China. Hainan: Jianfengling Natl. Nature Reserve, 18°51′N, 108°51′E, 980 m, 4 Sep. 2008, *Han Xu & H. Q. Chen JFL00876* (holotype, CANT). Figure 2.

Species *Aristolochiae championii* Merr. & W. Y. Chun et *A. bambusifoliae* C. F. Liang ex H. Q. Wen similis, sed ab eis caulibus glabris, calyce rufo tubo basali 23 26 × 5 6 mm et limbo perianthii 8–9 mm lato differt.

Lianas; stems woody, terete, glabrous. Leaves with the petioles 1.5–2.3 cm, densely yellow-brown villous; leaf blades lanceolate or elliptic-lanceolate, entire, 13–17.3 × 2.1–2.7 cm, leathery, abaxially mixed tomentum of yellow-brown villous and white pubescence, adaxially sparsely yellow-brown villous and white pubescence, veins pinnate, in 16 to 18 pairs, sparsely yellow-brown villous; base shallowly cordate, sinus < ca. 2 mm deep, apex acuminate. Flowers solitary; peduncles pendulous, 2.7–3.5 cm, densely yellow-brown villous; bracteoles lanceolate-ovate, ca. 0.4 × 1.1 mm, inserted at the peduncle bases, inconspicuous. Calyx externally light red-brown, 4.9–6.1 cm; throat pink with red-brown spots; calyx tube geniculate, externally densely yellow-brown villous; basal portion of tube 23–26 × 5–6 mm; calyx limb pink, 8–9 mm wide, margin revolute, unequally 3-lobed, the lower lobe with a short apex, adaxially densely papillate and white pubescent; stamens 6 in 1 series of 3 pairs; anthers oblong, ca. 2.4 mm, paired, 2-loculed, dehiscence longitudinal; ovary inferior, 6-loculed, mixed with long yellow-brown villous hairs and white pubescence; ovules numerous, usually in 1 series; placentation axile; gynostemium free, column 3-lobed, with a short, curved apex. Capsule not seen.

Distribution and habitat. Like *Aristolochia ledongensis*, *A. jianfenglingensis* is also only known from a single population found within the Jianfengling National Nature Reserve on Hainan Island, China. The type population was found at an altitude of just below 1000 m, rather higher than the altitude at which *A. ledongensis* was collected, under the canopy of tropical rainforest dominated by the families Lauraceae, Rubiaceae, Fagaceae, Palmae, and Myrtaceae.

IUCN Red List category. Within the Jianfengling National Nature Reserve, *Aristolochia jianfenglingensis* is known from only a single population, with fewer than five individuals seen. It is therefore assigned a preliminary status of Vulnerable (VU D2) according to IUCN Red List criteria (IUCN, 2001), indicating a population with a very restricted area of occupancy (typically less than 20 km^2) or number of locations (typically five or fewer). Although the sites that these two new species grew were disturbed about 15 years ago, there has not been further deforestation since then (Jian & Lu, 1991). More populations of these two species could remain to be found in similar habitats in these areas. However, an extensive field survey is needed, because the plants are inconspicuous and difficult to find in the field.

Phenology. Flowering specimens of the new species were collected in September and are known to bloom from July to September based on field observation.

Etymology. The specific epithet is derived from the Chinese Pinyin name of the collection locality of the holotype, Jian feng ling, with Ling referring to mountain.

Relationships. *Aristolochia jianfenglingensis* is most similar to *A. championii* and *A. bambusifolia*. The new species differs by having the stems glabrous (vs. densely villous), the exterior of the calyx light red-brown (vs. yellowish green), the basal portion of the calyx tube smaller (23–26 × 5–6 mm vs. 30–70 × 7–10 mm), and a narrower calyx limb (0.8–0.9 cm vs. 1.5–6 cm wide). Three other species of *Aristolochia* have been described in adjacent areas but differ significantly from *A. jianfenglingensis*. *Aristolochia jianfenglingensis* differs from *A. cathcartii* Hook. f.

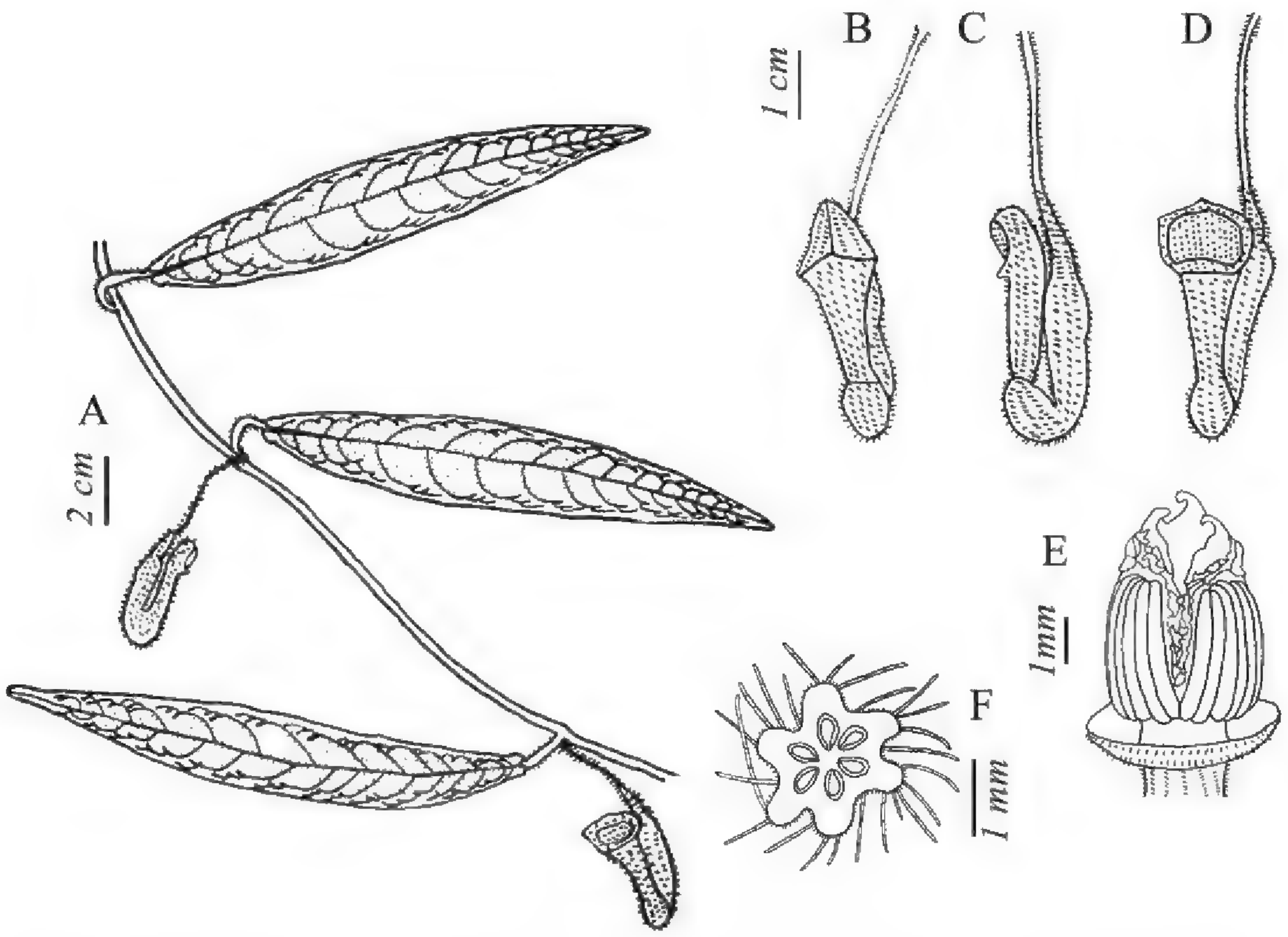

Figure 2. *Aristolochia jianfenglingensis* Han Xu, Y. D. Li & H. Q. Chen. —A. Flowering branch. —B. Closed flower. —C. Lateral view of open flower. —D. Face view of open flower. —E. Gynostemium. —F. Transverse section of ovary. Drawn by S. L. Lu from the holotype *Han Xu & H. Q. Chen JFL00876* (CANT).

(distributed from the eastern Himalayas to southern China) (Upson & Brett, 2006) and *A. saccata* Wall. (distributed in Bhutan, northeastern India, Myanmar [Burma], Nepal, and Sikkim) by having a smaller leaf blade (13–17.3 × 2.1–2.7 cm vs. 17–35 × 10–26 cm and 20–35 × 15–30 cm, respectively); it differs from *A. balansae* Franch. (distributed in Vietnam) by having densely yellow-brown villous leaves (vs. the leaves glabrous).

Like *Aristolochia ledongensis*, *A. jianfenglingensis* is also placed in subgenus *Siphisia*.

Paratype. CHINA. **Hainan:** Jianfengling Natl. Nature Reserve, under tropical rainforest, 18°51′N, 108°51′E, 980 m, 4 Sep. 2008, *Han Xu & H. Q. Chen JFL00877* (IBSC).

The two new species are morphologically similar in their lanceolate or elliptic-lanceolate leaf blades, solitary flowers, 2-loculed anthers, and 3-lobed gynostemium column. *Aristolochia ledongensis* differs from *A. jianfenglingensis* by the densely yellow-brown villous stems (vs. glabrous), the calyx externally yellow (vs. light red-brown), the calyx limb margin not revolute (vs. revolute), and the smaller basal portion of the calyx tube (15–16 × 4.5–5 mm vs. 23–26 × 5–6 mm).

The following key to 11 species of *Aristolochia* includes the two new species and their two most closely related species, as well as seven species found in Hainan Island and adjacent districts.

Key to Eleven Similar Species of *Aristolochia* in Hainan and China

1a. Calyx tube rectilinear or slightly curved; limb ligulate; gynostemium 6-lobed; anthers elliptic, opposite to lobes of gynostemium.
  2a. Leaf blades polymorphic, ovate or ovate-deltate to sagittate, 2.5 5.5 cm long ..... *A. polymorpha* S. M. Hwang
  2a. Leaf blades triangular-lanceolate to sagittate, 7 14 cm long ..... *A. austrochinensis* C. Y. Cheng & J. S. Ma
1b. Calyx tube horseshoe-shaped or geniculately curved at middle; limb often 2- or 3-lobed; gynostemium 3-lobed; anthers oblong, adnate in pairs opposite the gynostemium lobes.
  3a. Calyx limb expanded above, obliquely trumpet-shaped; orifice larger than tube ..... *A. hainanensis* Merr.
  3b. Calyx limb expanded above, discoid; orifice distinctly smaller than tube.

4a. Leaf blades polymorphic, margin deeply or shallowly lobed, rarely entire ..... *A. howii* Merr. & Chun
4b. Leaf blades uniform, margin entire.
5a. Leaf blades ovate-elliptic to oblong-elliptic, 7 12 cm wide ..... *A. fulvicoma* Merr. & Chun
5b. Leaf blades lanceolate or elliptic-lanceolate, usually < 7 cm wide.
6a. Basal portion of calyx tube > 7 mm wide.
7a. Calyx limb adaxially papillate; veins in 4 to 6 pairs.
8a. Calyx limb discoid, 4 6 cm diam., margin not revolute .... *A. championii* Merr. & Chun
8b. Calyx limb discoid, 1.5–2 cm diam., margin revolute
..... *A. bambusifolia* C. F. Liang ex H. Q. Wen
7b. Calyx limb adaxially smooth; veins in 6 to 16 pairs.
9a. Calyx purple with yellow blotches ... *A. fangchi* Y. C. Wu ex L. D. Chow & S. M. Hwang
9b. Calyx yellow with purple-brown blotches ..... *A. petelotii* O. C. Schmidt
6b. Basal portion of calyx tube < 7 mm wide.
10a. Stems densely yellow-brown villous; calyx limb margin not revolute; calyx exterior yellow; basal portion of calyx tube 15 16 × 4.5 5 mm .....
..... *A. ledongensis* Han Xu, Y. D. Li & H. J. Yang
10b. Stems glabrous; calyx limb margin revolute; calyx exterior light red-brown; basal portion of calyx tube 23 26 × 5 6 mm ..... *A. jianfenglingensis* Han Xu, Y. D. Li & H. Q. Chen

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Synonymy and Typifications in *Groutiella tomentosa* (Orthotrichaceae, Bryopsida)

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ABSTRACT. The results of morphological observation and principal component analysis indicate that *Groutiella laxotorquata* (Müll. Hal. ex Besch.) Wijk & Margad. is conspecific with *G. tomentosa* (Hornsch.) Wijk & Margad. Furthermore, the names *G. tomentosa*, *G. laxotorquata*, and *G. pobeguinii* (Paris & Broth.) Wijk & Margad. are lectotypified.

Key words: Bryopsida, *Groutiella*, *Macromitrium*, Orthotrichaceae.

Groutiella Steere is primarily a tropical to subtropical genus of 15 species in the moss family Orthotrichaceae (Crosby et al., 1999; Allen, 2002). *Groutiella tomentosa* (Hornsch.) Wijk & Margad. is the only species of this genus that occurs in both the Old and New World tropics. Vitt and Crum (1970) discussed the morphological variation of *G. tomentosa* and treated some species as synonyms of it. *Groutiella laxotorquata* (Müll. Hal. ex Besch.) Wijk & Margad. is an African taxon first described from Réunion. Bizot (1965, 1973) expanded its range considerably in Africa and added an additional four synonyms.

One of the most distinctive features of both *Groutiella tomentosa* and *G. laxotorquata* is the presence of subulate leaves with fragile apices, and indeed, this has been a diagnostic character for *G. tomentosa* (Gangulee, 1976; Vitt, 1994; Vitt et al., 1995; Allen, 2002) and is not found in any other species of *Groutiella*. In view of the variability of *G. tomentosa* and *G. laxotorquata* (Bizot, 1965, 1973; Vitt & Crum, 1970), the following study was undertaken to clarify the relationship between the two taxa.

MATERIALS AND METHODS

This study was conducted using specimens housed in H, HBG, MO, NSW, NY, PC, and PE, a total of 79 specimens (including eight types). All morphological characters were observed under stereoscopic and light microscopes. Comparative observations of papillae and spores were performed with a scanning electron microscope. In *Groutiella tomentosa* and *G. laxotorquata*, leaves vary considerably in shape and size based on their position on the stem, and therefore we selected only median leaves for measurements. Nine morphological characters were analyzed using the SPSS ver. 13.0 software package (SPSS Inc., Chicago, Illinois, U.S.A.). The morphological characters include branch length; leaf undulation, length, and width; leaf border proportions and the number of border cell rows; upper leaf cell length; basal leaf cell length; the shape of papillae on basal leaf cells; setae length; capsule length and diameter; and spore diameter.

RESULTS

PRINCIPAL COMPONENT ANALYSIS (PCA)

A data matrix for nine characters was obtained from 79 herbarium specimens. A total of 70.2% of the variation occurred in four components. Component 1 contained 22.3% of the statistical variation, mostly from leaf border cell rows, basal leaf cell length, and leaf length; component 2 varied by 18.3%, mostly from leaf length, leaf width, and leaf border proportions; component 3 varied by 16%, mostly from upper leaf cell length, branch length, and basal cell length; and component 4 varied by 13.4%, mostly from leaf undulation and branch length. PCA scatter plots (Fig. 1A, B) indicate that the two taxa cannot be separated.

MORPHOLOGY

Sporophytic characters were examined using SEM micrographs and numeric taxonomic assessment. Capsule shape and color were similar in *Groutiella laxotorquata* and *G. tomentosa*, and their peristomes and spores were also nearly identical.

TAXONOMIC TREATMENT

Groutiella tomentosa (Hornsch.) Wijk & Margad., Taxon 9: 51. 1960. Basionym: *Macromitrium*

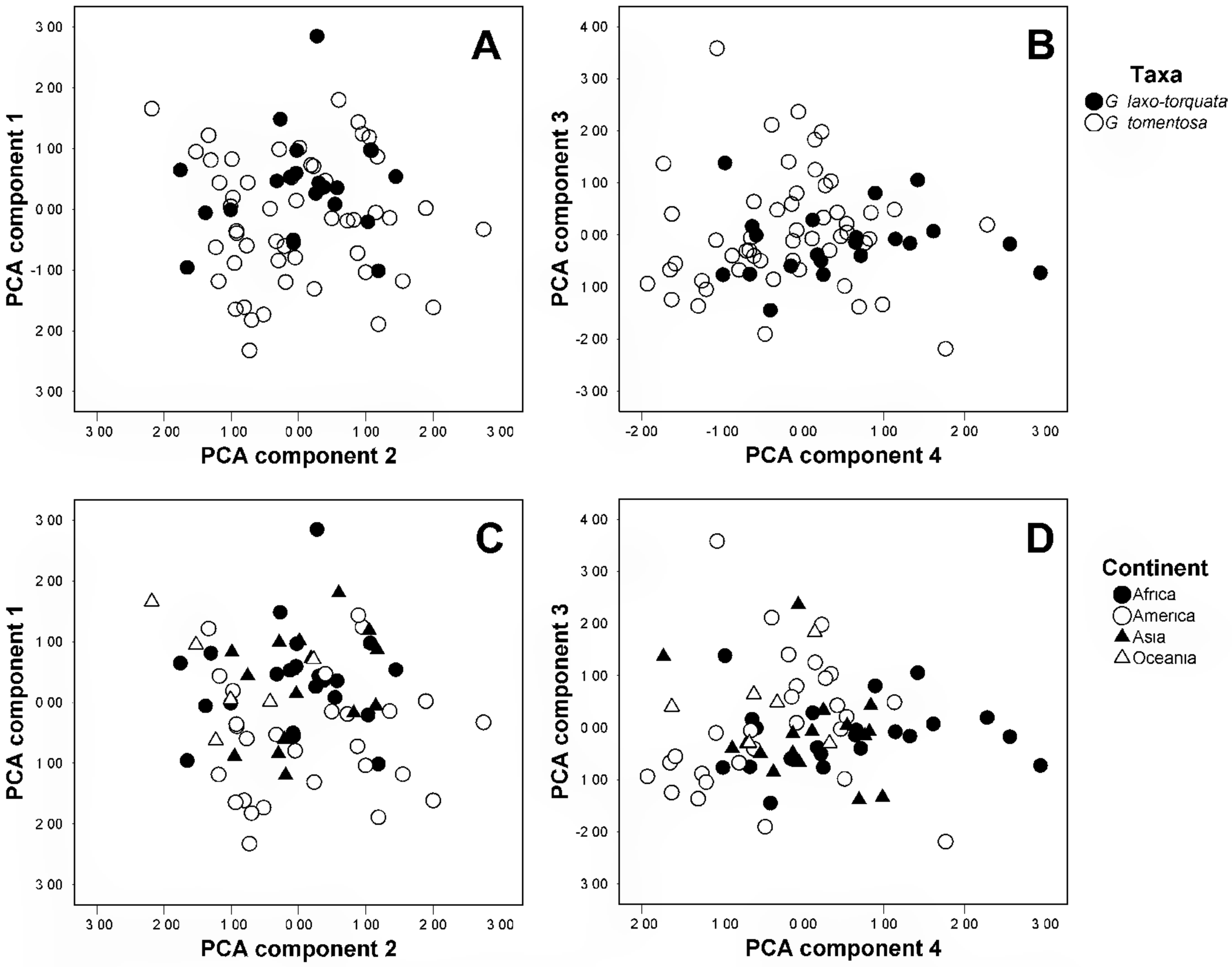

Figure 1. Scatter plots based on components 1–4 from PCA analysis of 79 specimens. —A, B. Scatter plots of taxa. —C, D. Scatter plots of different geographic populations.

tomentosum Hornsch., Fl. Bras. (Martius) 1(2): 21. 1840. *Micromitrium tomentosum* (Hornsch.) Paris, Index Bryol. 3: 242. 1905. TYPE: Brazil. "in campis montecidensibus," s.d., *F. Sellow s.n.* (lectotype, designated here, H-BR 2726013).

Groutiella laxotorquata (Müll. Hal. ex Besch.) Wijk & Margad., Taxon 9: 51. 1960, syn. nov. Basionym: *Macromitrium laxo-torquatum* Müll. Hal. ex Besch., Ann. Sci. Nat., Bot., sér. 6, 9: 362. 1880. TYPE: Mauritius. Mauritius Island, s.d., *V. de Robillard* (lectotype, designated here, H-BR 2725007).

Macromitrium pobeguinii Paris & Broth., Rev. Bryol. 31: 44. 1904. *Micromitrium pobeguinii* (Paris & Broth.) Paris, Mém. Soc. Bot. France 14: 26. 1908. *Groutiella pobeguinii* (Paris & Broth.) Wijk & Margad., Taxon 9: 51. 1960. TYPE: Guinea. Kankan, Kouroussa, "ad ramnlos editiores arborum viae, 1903," *H. Pobeguini s.n.* (lectotype, designated here, PC 0106740).

Discussion. The specimen at H (H-BR 2726013) corresponds to the original description for *Macromitrium tomentosum* Hornsch. [= *Groutiella tomentosa* (Hornsch.) Wijk & Margad.]; the label information shows that it was collected by Sellow in Brazil, and this location is the same as stated in the protologue (Hornschuch, 1840). Bernard Goffinet was the first to suggest this specimen as lectotype in his specimen notation. Because the holotype of *G. tomentosa* was destroyed at B during World War II, the specimen from H-BR is lectotypified here.

The specimen H-BR 2725007 corresponds to the original description of *Macromitrium laxo-torquatum* Müll. Hal. ex Besch. [= *Groutiella laxotorquata* (Müll. Hal. ex Besch.) Wijk & Margad.]. The label information shows that it was collected by V. de Robillard from Mauritius (ex Geheeb's herbarium), as indicated in the 1880 protologue by Müller. Because no further information was cited for the type in the protologue, we choose here for lectotypification the specimen that Bernard Goffinet first recommended on the specimen label at H-BR.

The specimen PC 0106740 corresponds to the original description of *Macromitrium pobeguinii* Paris & Broth. [= *Groutiella pobeguinii* (Paris & Broth.) Wijk & Margad.]. The label information agrees with the 1904 protologue by Paris and Brotherus. Because no specimen was cited in the protologue, the specimen from PC is lectotypified here.

The most significant diagnostic character for *Groutiella tomentosa* is the fragile leaf tips of the upper leaves, which readily break off (Bartram, 1949; Vitt & Crum, 1970; Crum & Anderson, 1981; Vitt & Ramsay, 1985; Vitt, 1994), but this character was also found in *G. laxotorquata*. Sometimes, the leaf tips of *G. tomentosa* may be broader and weakly dentate (Australia: *Norris 40897, 43099, 43108, 43540*; Bolivia: *Fuentes et al. 4060*; *Churchill & Arroyo 21527-B*; Brazil: *Reese 16161*; Mexico: *Reese 4447*; China: *Wen-Xuan Xu 11337*), and this variation has been observed in *G. laxotorquata* (Comoros: *Magill & Pócs 11432, 10960, 10947*). Also distinctive in *G. tomentosa* are the basal leaf cells, which are usually tuberculate and are a noteworthy feature in *Groutiella* species. In *G. laxotorquata*, the basal leaf cells are usually tuberculate as well, and the papillae can be up to 5 μm high (Guinea: *Norman s.n.*; Ivory Coast: *Frahm 802971*; Tanzania: *Brenan 1621*) or only a few bulging (Ghana: *Richards 6966*; Nigeria: *Jones 3936*). No significant differences in the papillae were observed between *G. laxotorquata* and *G. tomentosa*.

Groutiella tomentosa has the broadest distribution in *Groutiella* (Fig. 2). No one has yet investigated whether there is a relationship between distribution and the variation of the above morphological characters. To throw light upon this question, we made scatter plots based on specimens from different continents, using PCA components (results available from the authors). Our analysis indicates that there is no relationship between continental distribution and morphological characters (Fig. 1C, D); this conclusion is congruent with that reached by Vitt and Crum (1970: 148), where specimens "from the Old World, ... and also from the New World, all exhibit the entire range of variation of these characters." In our opinion, the morphological characters of *G. tomentosa* are relatively more variable, based on microenvironmental conditions rather than based on broader geographic distribution.

Specimens examined for PCA analysis, Groutiella tomentosa. ANGOLA. Cuarza River, *J. Boss s.n.* (MO). AUSTRALIA. **Queensland:** Cook, ca. 5 mi. S of Atherton, *D. H. Norris 43540* (NSW); Cook, above Tinaroo Dam, *D. H. Norris 40897* (NSW); Cook, end of Mt. Windsor Rd., *D. H. Norris 43099, 43108* (NSW). BELIZE. **Cayo:** Las Cuevas Field Station, *B. Allen 18062* (MO). **Toledo:** Columbia River Forest Reserve, *B. Allen 18613* (MO). BOLIVIA. **La Paz:** Franz Tamayo, arroyo Negro, *A. Fuentes, M. Villanueva & B. Guili 4060* (MO). **Santa Cruz:** Prov. Ichilo, Bosque Exp. Elías Meneses, *S. P. Churchill & L. Arroyo P. 21527-B* (MO). BRAZIL. **Amazonas:** "ibidem loco Tanaú," *R. Spruce 110c* (syntype, *Groutiella fragilis* (A. Jaeger) H. A. Crum & Steere [= *Groutiella tomentosa* (Hornsch.) Wijk & Margad.], NY 913261). **Pará:** Serra do Cachimbo, *W. D. Reese 16161* (MO); Base Aérea do Cachimbo & vic., *W. D. Reese 16128* (MO). **Sergipe:** Rio Tabora, Mpio. Itahaiana, *D. M. Vital 2874* (MO). CHINA. **Yunnan:** Simao Co., *Xu Wen-Xuan 6959, 11337* (MO, PE). COSTA RICA. **Guanacaste:** along sec. rd. 150 betw. Tilarán & Tronadora, *M. R. Crosby 3740* (MO). **San José:** Meseta Central, *I. Holz CR 99-1344* (MO). ECUADOR. **Galápagos:** Isla Santa Cruz, *W. A. Weber B-13523* (MO). **Sucumbíos:** Res. Faunística Cuyabeno, *R. RH 1990-332c* (MO). HONDURAS. **Atlántida:** Pico Bonito Natl. Park, *B. Allen 17285* (MO). **Comayagua:** trail from San José Del Los Planes to El Plan, *B. Allen 13755* (MO). **Copán:** along rd. to Agua Caliente at El Zapote, *B. Allen 17733* (MO). **Yoro:** Cordillera Nombre de Dios, N slope, *B. Allen 13513* (MO). INDONESIA. **Java:** Samarang prope Medini, monte Ungaran, s. coll. (type, *Groutiella goniorrhyncha* (Doxy & Molk.) E. B. Bartram [= *Groutiella tomentosa* (Hornsch.) Wijk & Margad.], NY 913248); Tjibodas, *Le Hans Winkler 176* (HBG). **Reindjani[?]:** Mt. Lombok?, *P. Sebert 1545* (NSW). **Sumatra:** s. loc., *Teysmann s.n.* (NY 913249). JAMAICA. **St. James Parish:** Montego Bay, *P. & E. Hegewald 8219* (MO). **St. Thomas Parish:** W of Arntully & May Hall, *M. R. Crosby 3350* (MO). MEXICO. **México:** 22–24 mi. WSW of Mexico City, *W. D. Reese 4447* (MO). **Veracruz:** Sierra de la Cruz, *F. Mueller 2261a* (syntype, *Groutiella schlumbergeri* (Schimp.) Wijk & Margad. [= *Groutiella tomentosa* (Hornsch.) Wijk & Margad.], NY 913256). NICARAGUA. **Estelí:** N slope of Cerro Tomabú, *W. D. Stevens 15016* (MO). **Jinotega:** ca. 2 km NW of San Rafael del Norte on rd., *W. D. Stevens & A. Grijalva 15070* (MO). PANAMA. **Panamá:** along rd. around Goofy Lake, *M. R. Crosby 4346* (MO). PAPAU NEW GUINEA. [Morobe: Yabim,] "Nova Guinea germanica: ad arbois prope Yabim," *J. Kaulfuss s.n.* (HBG, NSW). PHILIPPINES. St-Andre-des-Arts, *Paris s.n.* (HBG 2189-14). **Luzon Island:** Rizal Prov., *M. Ramos 12550* (NSW); Sablang Prov., *E. Fénix 12806* (NSW); Benguet Prov., Cordillera Admin. Region, *A. D. E. Elmer 8345* (NSW). SURINAME. **Brokopondo:** Brownsberg Nat. Reserve, *Zacharia Magombo 5325* (MO). **Para:** Joden Savanne, *B. Allen 19459* (MO). **Paramaribo:** s. loc., *M. J. Price 370* (NSW). **Sipaliwini:** Kayserberg Airstrip, *B. Allen 25041* (MO). THAILAND. **Northern:** Ban Mae Pang 30 km N of Mae Sariang, *Larsen et al. 2362* (MO); 30 km S of Bo Luang along Om Koi trail, *Larsen et al. 2060* (MO); Doi Pha Dam betw. Hang Dong & Bo Luang, *Larsen et al. 2197* (MO). **Peninsular:** Yala, *Charoenphol et al. 4140* (MO). **Prachinburi:** Khao Yai Natl. Park, Khao Khieo, *Larsen et al. 137, 224* (MO). TRINIDAD AND TOBAGO. **St. George:** Northern Range, near summit of Lalaja Rd., *M. R. Crosby 2145* (MO). COUNTRY UNKNOWN. Longbiou, s. coll. (HBG 2189-18). **Menigsea[?]:** Vecas Caiccy?, *Sumichrash s.n.* (NSW 792583).

Specimens examined for PCA analysis, Groutiella laxotorquata. CAMEROON. **Bipinde:** Urwaldgebiet, *G. Zenker 2186* (HBG 2189-13). COMOROS. **Anjouan (Ndzouani):** W of Gegi, *R. E. Magill & T. Pócs 11432* (MO). **Grande Comore (Ngazidja):** N of Massif du Kartala, *R. E. Magill & T. Pócs 10947* (MO); along rd. betw. Koimbani & Salimani, *R. E. Magill & T. Pócs 10960* (MO). GABON. **Gabon:** Chute De La Barrba, *Le Leits 6149* (HBG 2189-15). GHANA. **Eastern:** Ahuri Bot. Garden near Accra, *Richards 6302, 6966* (MO); Kade, Atewa Range, Mt. Aliwiredu, *Richards 6301* (MO). GUINEA. "Arbres pres de Bourouhadjo, Apr. 1901," *I. Norman s.n.* (holotype, *Groutiella limbatula* (Broth. & Paris) Wijk & Margad. [= *Groutiella laxotorquata* (Müll. Hal. ex Besch.) Wijk & Margad.], PC

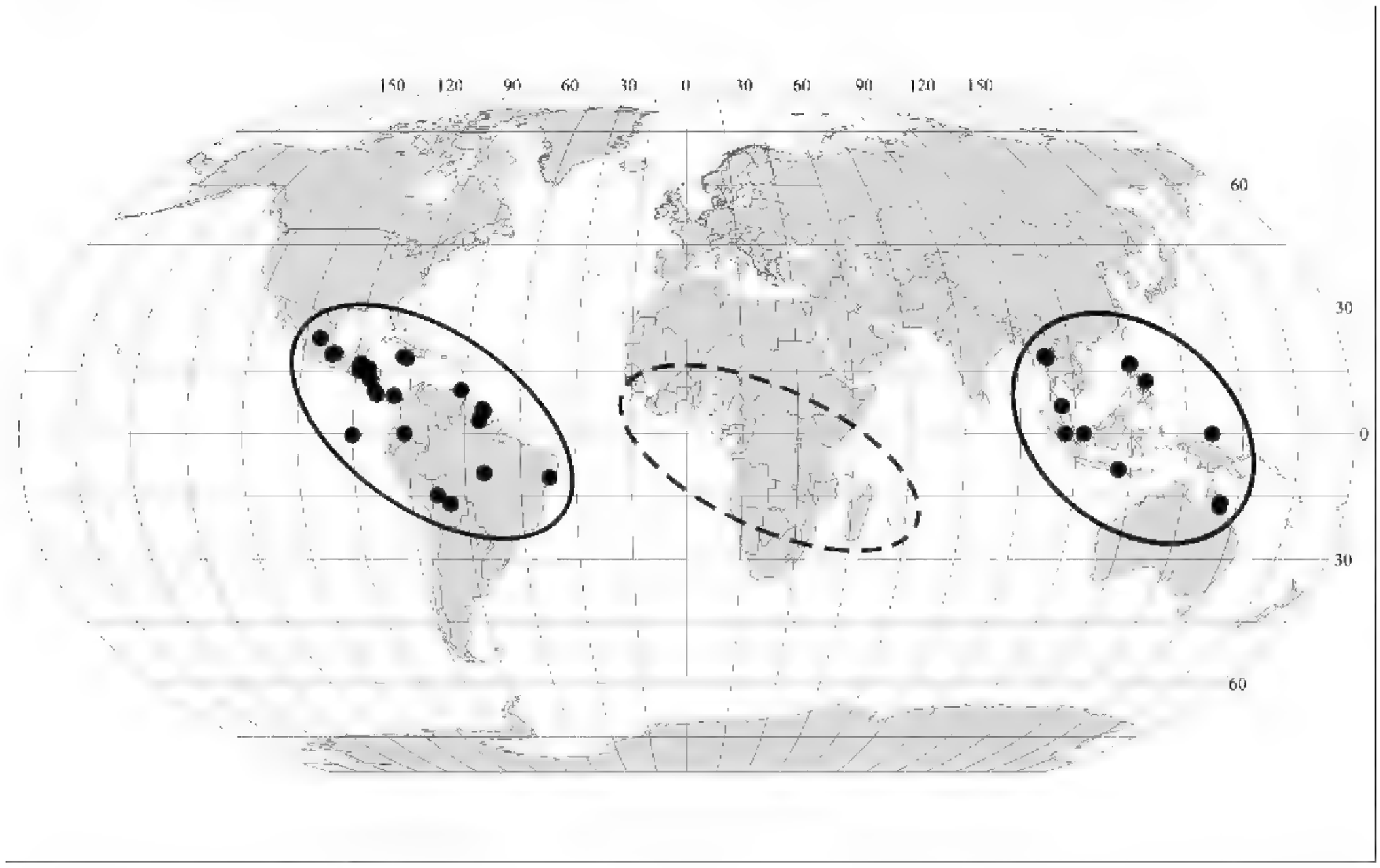

Figure 2. Distribution of *Groutiella tomentosa* and *G. laxotorquata* (= *G. tomentosa*). *G. tomentosa* (•) with solid line; *G. laxotorquata* (○) with dotted line.

0100087); "Arbres pres Dango, Mar. 1901," *I. Norman s.n.* (holotype, *Groutiella pleurosigmoidea* (Paris & Broth.) Wijk & Margad. [= *Groutiella laxotorquata* (Müll. Hal. ex Besch.) Wijk & Margad.], PC 0100086). IVORY COAST. **[Dix-Huit Montagnes:]** Man, Elfenbeinkueste, Mt. Toukovi Bei Man, *Frahm 802971* (MO). MAURITIUS?. s. loc., *W. Monkemeyer s.n.* (HBG 2189-16). NIGERIA. **Bendel:** Benin Prov., Okomu Forest Reserve, *Richards 3936* (MO). **Minna:** Abuja Distr., Garki Kuimi, *E. W. Jones 887* (MO). **Ogoja:** Ikom, Afi River Forest Reserve, *A. P. D. Jones 18947* (MO); Obudu division, Sonkwala area, *H. J. Savory & R. W. J. Keay 25141* (MO). SIERRA LEONE. **Western:** Leicester Peak, *Brenan s.n.* (MO). TANZANIA. **Tanga:** Korogwe Distr., *Brenan 1621* (MO).

Acknowledgments. We thank Marshall R. Crosby and two anonymous reviewers for their comments on the manuscript. We also thank the curators of H, HBG, MO, NSW, NY, and PC for specimen loans. This study was supported by the National Natural Science Foundation of China (No. 30570124).

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A New Species of Diploid Quillwort (*Isoetes*, Isoetaceae, Lycophyta) from Lebanon

Jay F. Bolin,[1,2] *Rebecca D. Bray*,[2] *and Lytton John Musselman*[2]*

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Abstract. A new species, *Isoetes libanotica* Musselman, Bolin & R. D. Bray (Isoetaceae, Lycophyta), is described from Akkar District of northern Lebanon. It is a seasonal terrestrial species of basaltic soils, diploid ($2n = 22$), with complete velum coverage. Megaspore diameter ranges from 338 to 477 μm with remote, low tuberculate ornamentation and a low to obsolete equatorial girdle; microspore length ranges from 25 to 30 μm, with echinate ornamentation. At the type locality of *I. libanotica*, two other *Isoetes* L. species occur sympatrically. These superficially similar *Isoetes* species can be differentiated from *I. libanotica* using megaspore characters; *I. duriei* Bory has larger alveolate megaspores and *I. olympica* A. Braun has a prominent equatorial girdle.

Key words: Isoetaceae, *Isoetes*, IUCN Red List, Lebanon, Lycophyta.

Like many other regions, our understanding of the diversity of quillworts in the flora of western Asia is limited. A review of the genus in this area, including Syria and Lebanon, reports the presence of four species (Bolin et al., 2008). This paper describes an additional new and largely cryptic species of *Isoetes* L. (Isoetaceae, Lycophyta) from Akkar District of northern Lebanon. This region includes an area of basalt spanning the border region of Lebanon and Syria at the northern terminus of the Mount Lebanon Ridge. The vegetation is typical eastern Mediterranean garigue (degraded evergreen oak/*Pistacia* L. forest) that is heavily grazed. Much of the region is unsuitable for agriculture because of the numerous boulders and basaltic scree. Frequent small depressions fill with water in the winter. During the French Mandate, malaria was brought under control (Longrigg, 1958) reportedly by draining these small ponds (K. Knio, pers. comm.). Recently, Musselman and Al-Zein (2010) found extensive populations of *I. duriei* Bory in this area that represented an eastern range extension for this widespread Mediterranean quillwort. In this same area, on both sides of the Lebanon-Syria border were populations of *I. olympica* A. Braun, previously thought to be limited to one site each in Turkey and Syria (Bolin et al., 2008). From this same area we describe a new and possibly endemic species.

Isoetes libanotica Musselman, Bolin & R. D. Bray, sp. nov. TYPE: Lebanon. Akkar Distr.: 339 m, 34′37.163″N, 36′14.976″E, 13 Apr. 2009, *M. S. Al-Zein & L. J. Musselman 2009-39c* (holotype, MO; isotype, BEI). Figure 1.

Haec species ab *Isoete duriei* Bory phyllopodiis absentibus atquemegasporis minoribus (diam. 338 477 vs. 600 800 μm) verrucosis, ab *I. olympica* A. Braun velo completo atque megasporae cingulo humili obsoletove differt.

Periodically submersed rosettes, forming plants with (10 to)20(to 50) sporophylls (leaves) (2–)4(–6)

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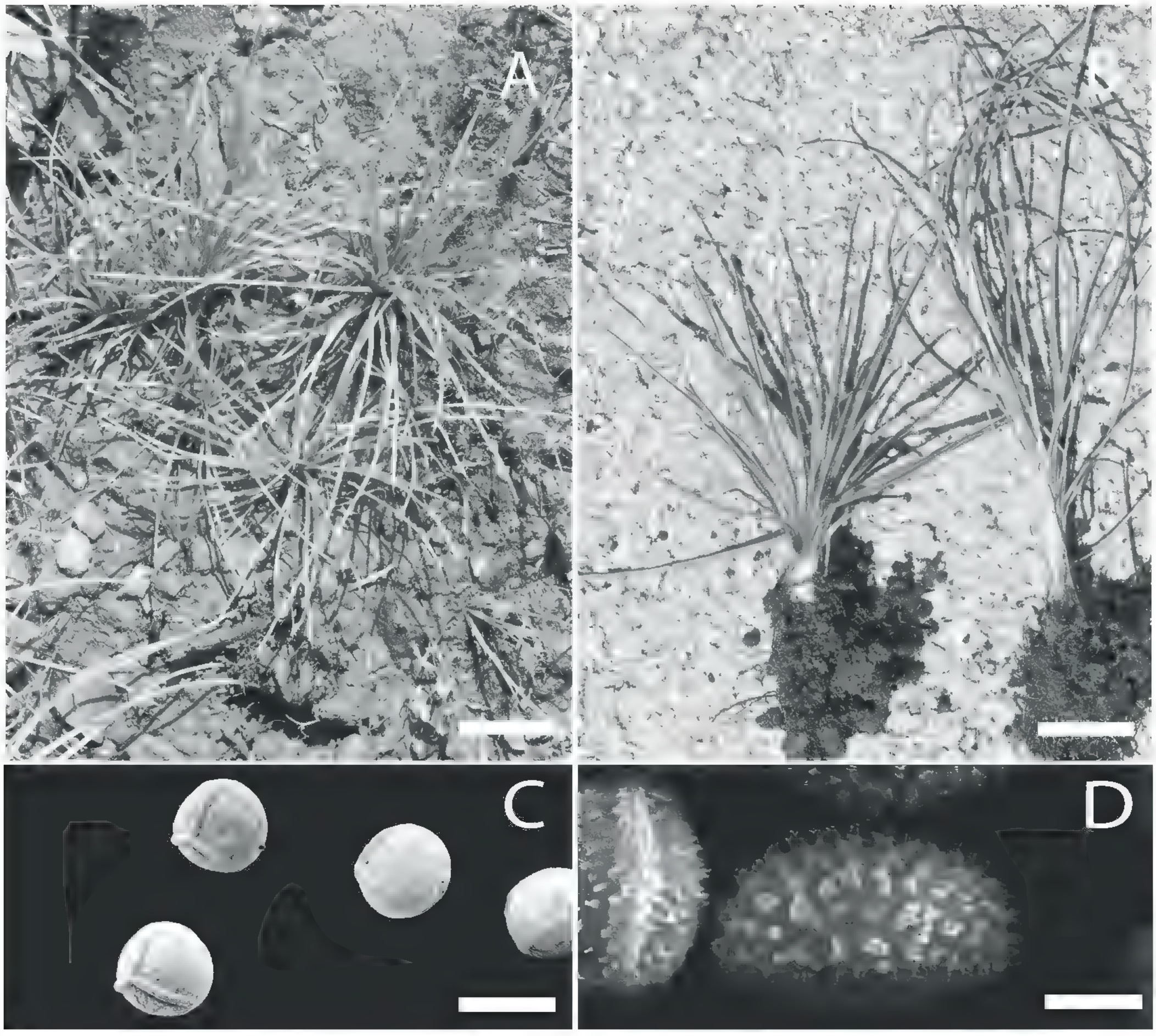

Figure 1. *Isoetes libanotica* Musselman, Bolin & R. D. Bray. —A. Habit. —B. Gross morphology showing variable depth of rootstock. —C. SEM of megaspores with low tuberculate ornamentation and low to obsolete equatorial girdle. —D. SEM of microspores with echinate ornamentation. Scale bars: A, B = 1 cm; C = 400 μm; D = 10 μm. Imaged from M. S. Al-Zein and L. J. Musselman *MSA 2006-11* (BEI).

cm (often much longer when submersed), semicircular in cross section with 4 vertical air chambers. Velum covering 100% of the sporangium. Scales tiny (ca. 0.5 cm), with acuminate apex, brown, readily falling from the 2-lobed rootstock. Phyllopodia not present. Roots numerous and dichotomously branched. Megaspores white, 338–477 μm diam. (mean — 339.2 ± 5.2 μm diam.) with low, widely spaced tubercles; triradiate ridges smooth, equatorial girdle low or obsolete (Fig. 1C). Microspores tan to brown en masse, 25–30 μm (mean — 27.3 ± 0.4 μm); widths 16–22 μm (mean — 19.4 ± 0.3 μm), echinate (Fig. 1D). Chromosomes: $2n$ — 22.

Distribution and habitat. *Isoetes libanotica* is known only from its type locality in Akkar District of northern Lebanon. The type locality is in an area of intensive agriculture where *I. libanotica* is frequent in depressions among the large boulders characteristic of this basaltic area, as well as in ponds and roadside ditches. It is likely that *I. libanotica* is also present in Syria due to the close proximity of the border (< 1.5 km) and the similar land use and geology to adjacent Lebanon. *Isoetes olympica* is interspersed with *I. libanotica* at the type locality and occurs just across the border in the vicinity of Khirbet Ghazi, Syria. Other vegetation associated with *I. libanotica* were *Sarcopoterium spinosum* Spach, *Calycotome spinosa* Link, *Coix lacryma-jobi* L., *Onopordum acanthium* L., *Asphodelus aestivus* Brot., as well as species of *Trifolium* L., *Anthemis* L., and *Echium* L.

IUCN Red List category. *Isoetes libanotica* should be considered Data Deficient (DD), according to IUCN Red List criteria (IUCN, 2001). Because the type locality has a long history of intensive agriculture, it is unlikely that this taxon is under immediate threat of extirpation under current land use schemes. However, without a better understanding of *I. libanotica* distribution, its conservation status cannot currently be estimated.

Phenology. This new species was collected in fertile condition in April and May. *Isoetes libanotica* dies back to its rootstock at the end of the rainy season like other terrestrial Mediterranean quillworts.

Diagnostic features. *Isoetes libanotica* occurs in mixed populations with *I. olympica* and *I. duriei* and is superficially indistinguishable. The simplest way to separate these three species is by the size of the megaspores and the velum coverage. *Isoetes libanotica* (338–477 μm) and *I. olympica* (360–450 μm) have similarly sized and smaller megaspores than *I. duriei* (600–800 μm). Velum coverage can be used to discriminate *I. libanotica* (complete velum) and *I. olympica* (incomplete velum). Moreover, plants of *I. libanotica* lack phyllopodia, which are hardened and sclarified leaf bases characteristic of *I. duriei* at the end of the growing season. Phyllopodia of *I. duriei* are black, short (< 3 mm), and tridented, but can be absent if sloughed off or may not form in a given season due to drought.

Discussion. Molecular ITS data support the recognition of *Isoetes libanotica* as a distinct taxon (Bolin et al., 2008: 450; annotated as "Lebanon Quillwort"). In the Bolin et al. (2008) ITS tree, *I. libanotica* forms a well-supported clade with *I. duriei* and *I. subinermis* (Durieu) Cesca & Peruzzi. *Isoetes libanotica* and *I. subinermis* share the base genus chromosome number of $2n = 22$, which suggests that either *I. libanotica* or *I. subinermis* (or both taxa) may have contributed to the parentage of the polyploid *I. duriei* (ca. $2n = 55, 104, 110, 134$). Perhaps more likely is that *I. duriei* is polyphyletic and the result of numerous independent hybridization events. However, these hypotheses require validation using DNA-based parental lineage–sorting techniques.

Because *Isoetes libanotica* and *I. olympica* co-occurred at the type locality, we generated ITS sequences from representative individuals (*I. libanotica*: *MSA 2009-39c*, BEI, MO, GenBank accession GU591479; *I. olympica*: *MSA 2009-39b*, MO, GenBank accession GU591480). Molecular methods corresponded to those in Bolin et al. (2008), and our results confirmed the identities of the two morphologically and molecularly distinct but superficially similar taxa.

Mouterde (1966) described two species of *Isoetes* from the Levant, *I. olympica* and *I. histrix* Bory f. *subinermis* Durieu, the latter elevated to specific level by Cesca and Peruzzi (2001), with the taxa distinguished by ploidy levels and spore morphology. The presence of *I. olympica* (Bolin et al., 2008), *I. duriei* (Musselman & Al-Zein, 2010), and *I. libanotica* in Lebanon are confirmed in this paper. However, the status of *I. subinermis* in Lebanon remains ambiguous. Major characters shared by *I. subinermis* and *I. libanotica* include ploidy level ($2n = 22$), complete velum coverage, and tuberculate megaspore ornamentation. Thus, it was possible that the new species was mistaken by Mouterde for *I. subinermis* (Durieu) Cesca & Peruzzi [= *I. histrix* f. *subinermis* Durieu]. The megaspore tubercles of *I. subinermis* are densely arranged and low, while those in *I. libanotica* are widely spaced and low. Thus, the two species can be easily discriminated if *I. subinermis* is indeed present in Lebanon.

Key to *Isoetes* of Lebanon

1a. Megaspores with alveolate ornamentation, > 600 μm diam ..... *I. duriei*
1b. Megaspores with tuberculate ornamentation, < 500 μm diam.
  2a. Velum incomplete; megaspore equatorial girdle height equal to height of triad arms ..... *I. olympica*
  2b. Velum complete; megaspore equatorial girdle low or obsolete relative to height of triad arms ..... *I. libanotica*

Paratype. LEBANON. **Akkar Distr.:** Menjez [as "Menges"], 16 May 2006, *M. S. Al-Zein & L. J. Musselman MSA 2006-11* (BEI).

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Cesca, G. & L. Peruzzi. 2001. *Isoetes* (Lycophytina, Isoetaceae) with terrestrial habitat in Calabria (Italy). New karyological and taxonomical data. Fl. Medit. 11: 303–309.

IUCN. 2001. IUCN Red List Categories and Criteria, Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland, and Cambridge, United Kingdom.

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Musselman, L. J. & M. S. Al-Zein. 2010. *Isoetes duriei* new to Lebanon. Amer. Fern J. 99: 333–334.

Review of Chinese *Spiraea* (Rosaceae, Spiraeoideae) with Simple Inflorescences

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Abstract. Several morphotypes of simple inflorescences occurring in the genus *Spiraea* L. (Rosaceae), widely used for classification and determination, but not uniformly interpreted in the literature, are correctly defined. Taxonomically, *S. compsophylla* Hand.-Mazz. is synonymized with the imperfectly known *S. calcicola* W. W. Sm., whose amplified description and illustration are added. A newly distinguished species, hitherto confused with the former name, is described from Yunnan Province in China and illustrated as *S. adiantoides* Businský, with its assignment to section *Glomeratae* Nakai. Two imperfectly known and confused species of *Spiraea* sect. *Chamaedryon* Ser. from Taiwan, *S. tarokoensis* Hayata and *S. tatakaensis* I. S. Chen, are carefully described, illustrated, and compared with six similar Chinese species. A new variety, *S. lasiocarpa* var. *villosa* Businský, is described from western Sichuan Province, accepting the concept that *S. lasiocarpa* Kar. & Kir., described from today's eastern Kazakhstan and hitherto neglected in Chinese floras, is the correct name for the Chinese taxon *S. mongolica* Maxim. Two imperfectly known taxa from southwestern Sichuan, *S. muliensis* T. T. Yu & L. T. Lu and *S. daochengensis* L. T. Lu, were found to be conspecific after comparison of their respective holotypes and a newly found population; the former is accepted as the correct name. *Spiraea sericea* Turcz. is accepted only at the rank of the variety as *S. media* Schmidt var. *sericea* (Turcz.) Maxim. A key to the Chinese species of *Spiraea* with simple inflorescences is newly compiled, encompassing 40 species.

Key words: China, IUCN Red List, Rosaceae, *Spiraea*.

Seventy species of the genus *Spiraea* L. (Rosaceae, Spiraeoideae) have recently been reported from China, including Taiwan, in the *Flora of China* treatment (Lu & Crinan, 2003). However, certain oversights exist in the treatment of this taxonomically critical genus. These concern certain characters in some imperfectly known species, as well as the wording used in certain group leads in the key to species. As a result of a field study, two species pairs with simple inflorescences from Yunnan and Taiwan that had been hitherto confused are newly distinguished here. One species from each pair is found either as a new species or as one neglected for the Chinese flora. Inflorescence type has traditionally been the most important character used to classify the genus *Spiraea*, but a certain confusion in its interpretation exists. Two principal inflorescence types are found in this genus, distinguished as those with 1-flowered pedicels (simple inflorescences) or those with branched pedicels (compound inflorescences). Both types are of indeterminate (racemose) character, i.e., the lower flowers (for compound inflorescences, those of each segment) open first. Although these two inflorescence types discriminated infrageneric division within the genus (for the history of its classification, see Businský & Businská, 2002), recent molecular analyses (Potter et al., 2007) reveal that neither inflorescence type is monophyletic. Maximowicz (1879: 173), in his comprehensive classification of the genus, concisely defined inflorescences of true spiraeas as "flores haud vere racemosi, pedicellis inaequilongis." He indicated the simple type as "corymbi vel fasciculi pedicellis 1-floris" and the compound type as "corymbi vel paniculae compositae." Schneider (1905: 449, 450, 454) described inflorescences of the subgenus *Euspiraea* C. K. Schneid. (the genus *Spiraea* by today's concept) in German as "± scheindoldig, einfach doldentraubig oder ± zymös verästelt, nie deutlich gestreckte Trauben." He divided the simple type into one group with "Blütenstand doldig, sitzend" and another group with "Blütenstand stets ± doldentraubig, gestielt." Rehder (1927: 333, 1940: 328) indicated the simple types similarly as "sessile umbels" and "umbel-like racemes on leafy branchlets." Of these three cited authors, Maximowicz's definition is the most accurate. The simple inflorescence type found in *Spiraea* is always determined by its lateral position on the previous year's shoots. They differ only in the length of the inflorescence axis, the continuing peduncle, and short branchlet. This length difference can be understood as an increase (in agreement with most

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old classifications, e.g., Maximowicz, 1879; Zabel, 1893; Schneider, 1905; Rehder, 1927, 1940) or a decrease (in agreement with the concept founded by Nakai, 1916; modified by Pojarkova, 1939, and Yu & Kuan, 1963; and used in Chinese floras: Yu & Lu, 1974; Lu & Crinan, 2003; i.e., probably in agreement with evolutionary trend). These morphotypes can be divided and taxonomically applied in the following way: (1) sessile flower fascicles (arising from lateral winter buds) appearing as nonstalked umbels, with a basal leaf rosette; (2) shortly pedunculate (subsessile), congested corymbs, with a basal leaf rosette; (3) corymbs or racemose (elongated) corymbs on a peduncle that continues as a leafy short branchlet; and (4) seeming umbels on a peduncle that continues as a leafy short branchlet. The first and second morphotypes have been traditionally classified as *Spiraea* sect. *Glomeratae* Nakai, the latter two as *Spiraea* sect. *Chamaedryon* Ser. in a narrower concept (Yu & Kuan, 1963; Yu & Lu, 1974; Businský & Businská, 2002). The term umbel-like or umbellate raceme used by several authors is equivocal and can be understood as a simple corymb, i.e., an intermediate form between raceme and umbel (as used in the key and elsewhere in the *Flora of China* treatment by Lu & Crinan, 2003, in contrast to umbel), or as the collective term for simple corymb and umbel (Rehder, 1927, 1940). Maxwell and Knees (1995) used the term corymb for sessile flower fascicles and seeming umbels, or for the true (simple) and also compound corymbs (they usually did not use the designation as compound). They alternatively also used the term raceme, but only for *S. media* Schmidt. The seemingly umbellate morphotype found in the genus *Spiraea* is only an approximate analogy, where the pedicels are ± equally long and densely crowded together, but they do not arise strictly from the same point. A few isolated flowers on a similarly long pedicel as shifted down on the peduncle may also often occur. The racemose corymb, as a variant of simple corymbs within the above-mentioned third morphotype, is an intermediate form between raceme and corymb, and can be defined as an elongated corymb with the lower pedicels only indistinctly longer than upper ones. Racemose corymbs typically occur, for instance, in *S. media*.

Together with my wife, Ludmila Businská, we carried out a series of research expeditions to China, where all taxa of the genus *Spiraea* that we found in nature were sampled (Businský & Businská, 2002: 11). In addition to these cited specimens, most *Spiraea* collections at PE and KUN were also examined.

Two Taxonomically Confused Species of *Spiraea* from Northern Yunnan

Two similar taxa of the genus *Spiraea* with simple umbel-like, subsessile, lateral inflorescences on the previous year's shoots and heteromorphic leaves were described from northwestern Yunnan under the names *S. calcicola* W. W. Sm. and *S. compsophylla* Hand.-Mazz. The former was described (Smith, 1913) from an elevation of ca. 3500 m from Yulongxue Shan north-northwest of Lijiang. The latter name was described (Handel-Mazzetti, 1933) based on the author's own material from 3200 m in the mountains situated to the southeast above what is today Luoji at the eastern margin of Zhongdian Xian near the Sichuan border. Although these localities are found today in different prefectures (Lijiang and Diqing, respectively), they are situated only 70 km from one another. Yu and Kuan (1963) listed both taxa separately as members of *Spiraea* (sect. *Glomeratae*) ser. *Hypericifoliae* Pojark. ex T. T. Yu. Both taxa were also treated as separate species in Chinese floras (Yu & Lu, 1974; Lu & Crinan, 2003), and the same relevant illustration of both was given in one plate in both publications (Yu & Lu, 1974: 61, t. 8; Wu & Raven, 2004: 34). Beyond the various leaf shapes and fruits discussed for both taxa, the plate in question contained a flowering branchlet of *S. calcicola* and a fruit-bearing branchlet of *S. compsophylla*, which are hardly comparable. Both taxa were also accepted separately in the *Index Florae Yunnanensis* (Institutum Botanicum Kunmingense Academiae Sinicae, 1984: 542), with *S. calcicola* given from between 2700 and 3600 m elevation, and *S. compsophylla* from between 2000 and 4000 m. Detailed study of the type material for both *S. calcicola* and *S. compsophylla* revealed both taxa perfectly conspecific, characterized principally by the distinctly angled, dark brown shoots and branchlets. By nomenclatural priority, Handel-Mazzetti's name synonymizes to Smith's older one.

Spiraea calcicola W. W. Sm., Notes Roy. Bot. Gard. Edinburgh 8: 131. 1913. TYPE: China. Yunnan: [Lijiang Xian], crevices of dry limestone cliffs on the eastern flank of the Lichiang Range [Yulongxue Shan], 27°20′N [27°10′N], 11,000–12,000 ft., June 1910, *G. Forrest 5730* (holotype, E not seen; isotype, PE). Figure 1.

Spiraea compsophylla Hand.-Mazz., Symb. Sin. 7: 450, pl. 13, fig. 1. 1933, syn. nov. TYPE: China. Yunnan: "Inter pagos Yungning und Dschungdien (Chungtien) [Zhongdian], in regionis temperatae rupibus aridis montis Lamatso. Substr. Calceo, ca. 3200 m," 12 July 1915, *Handel-Mazzetti 7608* (holotype, W).

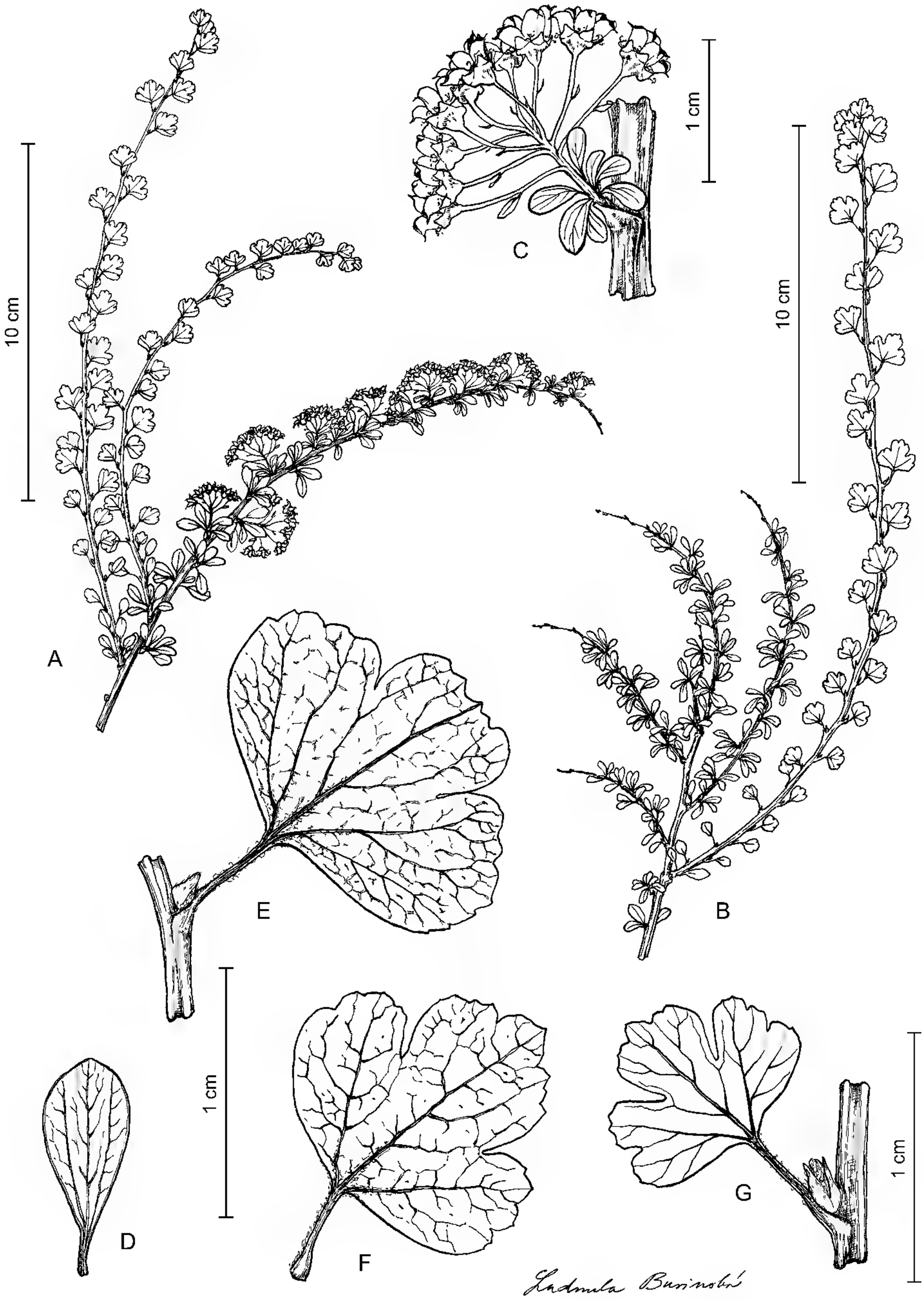


Figure 1. *Spiraea calcicola* W. W. Sm. —A. Fertile branch with two young long shoots. —B. Three-year portion of sterile branch with one young long shoot. —C. Inflorescence in fruit with basal leaf rosette. —D. Leaf from inflorescence basal rosette, abaxial view. —E, F. Fully developed leaves of sterile long shoots, abaxial view. —G. Fully developed leaf of sterile long shoot, adaxial view. Drawn by Ludmila Businská from July collection, *R. Businský 30409* (G), at the type locality.

Shrubs to 1–1.5 m tall, densely branched, with longer branches ± arcuate, angled, grayish dark brown from second year; sterile long shoots of the present year (fully developed only from July) to ca. 25(–40) cm, usually arcuate, dark reddish brown, conspicuously angled with irregular ridges and grooves, sparsely pubescent to glabrescent, not cracking or peeling in the following year; buds elongate-conical, usually shorter or equal to half of petiole, with several sparsely pilose scales. Leaves deep green adaxially, grayish green and not papillose abaxially, with margin somewhat thickened, not revolute; venation reticulate, deep green,

contrasting abaxially; leaf blades, as reduced in basal part of sterile long shoots, often slightly longer than wide, broadly angular-obovate and ± narrowly cuneate; blades fully developed in middle and apical portions of shoots, wider than long, transversally rounded rhombic and broadly cuneate or truncate to subcordate at base, (5–)7–10(–12) × (6–)8–14(–16) mm, 3-lobed or rarely 5-lobed, with notches shallow to more than half deep, all lobes ± truncate or middle lobe broadly triangular, in front irregularly crenulate, crenate, or coarsely and obtusely dentate but with the apical tooth often pointed; initially very sparsely pilose to almost glabrous ± equally on both surfaces, more pilose only on base of principal veins abaxially; venation consists of three principal veins branching at one point at the triangular basal connection to petiole; petioles (2–)3–5(–6) mm, ± sparsely pilose, with basal lateral edges decurrent into longitudinal shoot ridges, basal part persists after shedding the leaves; leaf blades of lateral rosettes at the inflorescence base and on lateral shortest sterile branchlets of older twigs entire, obovate, with narrowly cuneate base and rounded apex, (2.5–)4–7(–9) × (1.5–)2.5–3.5(–4.5) mm, glabrous on both surfaces, 3-veined; petiole to ca. 2 mm. Inflorescences densely arranged, usually 10 to 30, set laterally on arcuate branches (changed from previous year's long shoots), each with basal leaf rosette; basically shortly pedunculate corymbs, on less vigorous branchlets congested, sessile and therefore of umbel-like form, on lower flowering portion of more vigorous branchlets with the peduncle to ca. 12 mm, with distant pedicels; corymbs with (6)7 to 12(to 26) flowers on firm, glabrous, unbranched pedicel usually with narrow bract, rarely some lower pedicels branched, with several flowers. Hypanthium campanulate, thickly walled, firm and fragile when dry, externally entirely glabrous, smooth, light brown, inside with usually sparse, long hairs, ca. 2.5 mm diam. in fruit; sepals triangular, 0.7–1.4 × 1–1.6 mm, externally glabrous, inside finely pubescent or glabrescent, erect-spreading in fruit. Follicles erect-spreading to erect, sparsely hairy only along ventral suture or entirely glabrous, with erect-spreading styles.

Habitat and distribution. *Spiraea calcicola* occurs on rather sunny limestone, rocky, or scree substrates between 2700 and 4000 m, often under sparse pine stands of *Pinus densata* Mast. or *P. armandii* Franch. This taxon is known only from northwestern and northeastern Yunnan, China.

IUCN Red List category. Least Concern (LC; IUCN, 2001).

Notes. The protologue of *Spiraea calcicola* (Smith, 1913) and its subsequent description in the *Flora of China* treatment (Lu & Crinan, 2003: 72) above all did not consider the sterile long shoots, especially their specific leaf morphology. These are described only in Handel-Mazzetti's Latin protologue (1933) for the synonymous *S. compsophylla* based on the only specimen cited. A more complete description and a new illustration are therefore given here, based on additional specimens examined and from a study of the species at two localities. However, both visits were during fruiting season, and therefore flowers in blossom are not described, but expected to be in May or June.

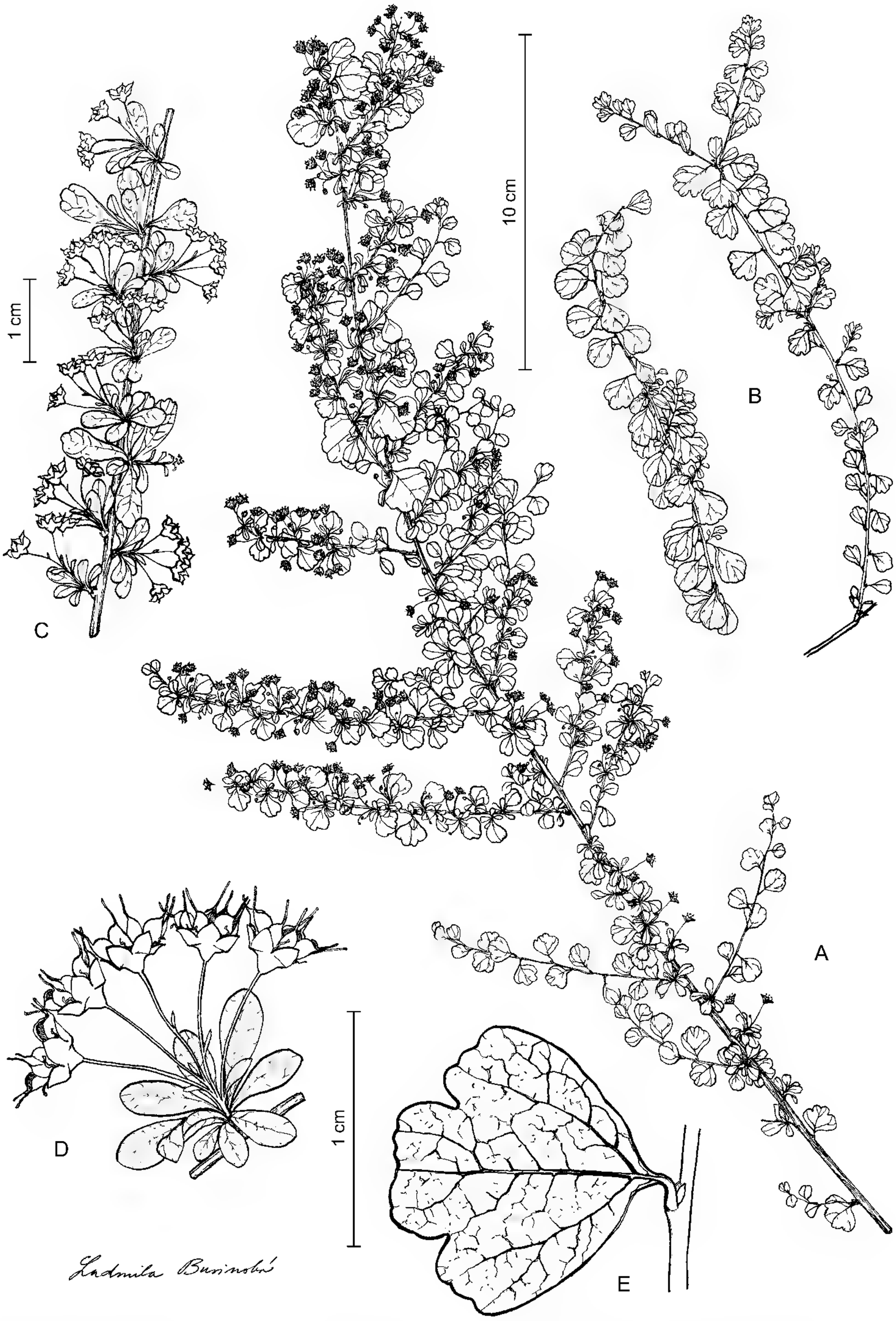
During our first expedition to Yunnan in 1990, we found and also collected *Spiraea calcicola* in the region of its type locality on Yulongxue Shan, and the second entity, represented to date by the name *S. compsophylla*, at its oldest documented locality near Qiaotou from 1939. We also found the former species in 1998 at a new locality in the northeastern corner of Yunnan (near the Sichuan border) on Yao Shan (Qiaojia Xian).

Selected specimens. CHINA. **Yunnan:** Zhongdian Xian, N flank of Haba Snow Range, *K. M. Feng 1257* (KUN, PE); Likiang [Lijiang] Xian, Likiang Snow Range, *Zang 8938* (KUN, PE); Zhongdian Xian, Sanqi Xiang, ?*Shen 21035* (KUN, PE); Lijiang Pref. & Xian, Yulongxue Shan, E foot above rd. from Lijiang to Daju, in valley ca. 2 km W of Heishui, *R. Businský 30409* (G, Silva Tarouca Research Institute for Landscape and Ornamental Gardening [RILOG] herbarium); Zhaotong Pref., Qiaojia Xian, Yao Shan, upper NW slopes of great steep rocky amphitheatre above Kangjiahe, *R. Businský 46405* (G, RILOG herbarium).

The following undescribed species is discriminated here from material of the misinterpreted *Spiraea compsophylla* and is presented below as a new species.

Spiraea adiantoides Businský, sp. nov. TYPE: China. Yunnan: Diqing Pref., Zhongdian Xian, S foot of Habaxue Shan, Hutiaoxia (Tiger Leap Gorge), Jinsha Jiang (Yangtze river) valley ca. 4 km ENE from mouth of Xiaozhongdian He at Hutiaoxiazhen (Qiaotou), fissures of almost vertical rocks of crystallic limestone, 1950 m, 27°11′N, 100°06′E, 12 July 1990, *R. Businský 30403* (holotype, G; isotypes, MO, RILOG herbarium). Figure 2.

Haec species inter congeneros sinenses ad *Spiraeam* sect. *Glomeratas* Nakai pertinentes quoad ramos elongatos sicut ramulos teretes primo pallide brunneos atque folia heteromorpha utrinque glabra *Spiraeae kwangsiensi* T. T. Yu simillima, sed ab ea ramis elongatis omnino glabris atque ramorum elongatorum sterilium laminis foliaribus late angulari-obovatis usque transverse rotundato-rhombicis, plerumque 3-lobis ac 3-veniis, abaxialiter manifeste



Ludmila Businská

Figure 2. *Spiraea adiantoides* Businský. —A. Fertile branch in July of second year. —B. Two sterile long shoots with secondary lateral summer shoots. —C. Portion of fertile branch. —D. Inflorescence in fruit with basal leaf rosette. —E. Fully developed leaf of sterile long shoot, abaxial view. Drawn by Ludmila Businská, parts A and E from the holotype, *R. Businský 30403* (G), B–D from isotypes.

cinereo-pruinosis venatione atroviridi discrepante distinguitur.

Shrubs to 50 cm tall, pruinose and generally glabrous, with slender, straight, terete branches; long shoots and branchlets conspicuously slender, terete, entirely glabrous, pale brown, initially smooth, cracking later, and peeling into longitudinal strips in the second year; buds small, subconical, shorter than petiole, with several scales sparsely pilose especially along margin, often sprouting during the first summer in vigorous shoots. Leaves pale green adaxially, conspicuously grayish pruinose and papillose abaxially, with revolute margin; venation reticulate, deep green, contrasting abaxially, in principal veins distinct adaxially; leaves entirely glabrous on both surfaces or only some young leaves with a few hairs on the petiole or principal veins abaxially; leaf blades of long shoots and lateral rosettes or shortest branchlets unequal in shape and size; blades on sterile long shoots more variable, broadly angular-obovate to transversally rounded rhombic, often wider than long with broadly cuneate to almost truncate base, or blades narrower, but at most 1.5× longer than wide with a minimum base angle ca. 55°, (3–)6–12(–17) × (2.5–)6–12(–18) mm, excluding petiole; irregularly shallowly and orbicularly 3-lobed or only crenate to almost entire, middle lobe truncate, retuse, or crenulate, lateral lobes similar, but more irregular; venation consists of 3 principal veins branching at almost one point above base; petioles 1–2.5 mm, with 1/3–1/2 remaining after leaf fall; leaf blades of lateral rosettes at the inflorescence base small, entire, obovate or spatulate, with narrowly cuneate base and rounded to obtuse apex, to 6.2 × 2.7 mm, including the petiole to 0.5 mm long, with one principal vein pinnately branched; blades on lateral shortest sterile branchlets of older twigs (usually also in rosettes) similar but somewhat more variable, to 9 × 4 mm including petiole, entire or often shallowly 3- or 4-lobed; leaves on long shoots persist usually until second half of following year, thus inflorescences with the basal rosette of small entire leaves appear in axils of larger, lobed, broadly cuneate leaves from previous year. Inflorescences umbel-like, congested, few-flowered corymbs set laterally on straight branchlets (changed from previous year's long shoots); corymbs sessile or more often on (1–)2–3(–4) mm peduncle with basal leaf rosette in axil of previous year's leaf or its remnant petiole, bearing (3)4 or 5(to 7) flowers, each always singly on pedicel 5–7(–9) mm, slender, lax, usually entirely glabrous (sometimes with only sporadic hairs), grayish, the lower pedicel usually with diminished leaf at base, upper pedicels with small, narrowly ligulate bract at base, the top pedicel with minute bract shifted up. Hypanthium campanulate, thinly walled, externally usually entirely glabrous (sometimes with sporadic hairs), grayish brown, inside with long white hairs, 1.6–2.3 mm diam. in fruit; sepals rounded triangular, 0.9–1.2(–1.4) mm, externally glabrous, inside finely pubescent or glabrescent, erect to spreading in fruit; petals obovate with retuse apex, 2.9–3.5 × 1.9–2.2 mm; stamens ca. 20, shorter than petals, with filaments (1.3–)1.5–1.7(–1.9) mm; staminal disk indistinct, interrupted, formed by 10 small, rounded, lobed glandules; carpels inside, including bases of styles, with long whitish hairs. Follicles erect and parallel in maturity, 2.2–2.7 mm, sparsely hairy only along ventral suture; styles ca. 1 mm, dorsal, almost spreading.

Habitat and distribution. The new species occurs in fissures of open, sunny limestone rocks between 1700 and 2200 m along the foot of high mountain ranges, and is known only from two areas in northwestern Yunnan, China, at a distance of ca. 150 km.

IUCN Red List category. Vulnerable (VU; IUCN, 2001).

Phenology. *Spiraea adiantoides* flowers mostly in April to May.

Paratypes. CHINA. **Yunnan (NW):** Chungtien [Zhongdian], betw. Chiao-tou [Qiaotou] to Ya-chang-gou SE of Haba Snow Range on Yangtze, 23 Mar. 1939, *K. M. Feng 567* (KUN [2], PE); Gongshan, Sigitong, 2000–2200 m, 20 Sep. 1940, *K. M. Feng 7988* (KUN [2], PE [3]); Gongshan, Azhong Luo, 1700 m, 25 May 1960, *Chinese Collector 8746* (KUN, PE [2]).

Two Taxonomically Confused Species of *Spiraea* from Taiwan

According to relevant Chinese floras (Li, 1963; Yu & Lu, 1974; Ohashi & Hsieh, 1993; Lu & Crinan, 2003), only five species of the genus *Spiraea* are known from Taiwan. Three of them, *S. formosana* Hayata, *S. hayatana* H. L. Li, and *S. morrisonicola* Hayata, all with terminal compound corymbs, are traditionally classified into section *Calospira* K. Koch. Of the two species with simple inflorescences, *S. tarokoensis* Hayata from section *Chamaedryon* has umbel-like corymbs on short, lateral, leafy branchlets on the previous year's shoots, and *S. prunifolia* Siebold & Zucc. from section *Glomeratae* has sessile flower fascicles on the previous year's shoots (both according to the infrageneric classification of Yu & Kuan, 1963). In November 2008 during the ascent of the highest Taiwanese mountain, Yushan (Mt. Jade,

3952 m), along the classic tourist path from Tataka Visitor Center, the present author found a sporadic, low shrub of *Spiraea* growing on a sparsely wooded slope at 2800 m elevation (cf. *R. Businský 66401*). This shrub represents the group of typically seemingly umbellate species hitherto classified as an unspecified part of series *Trilobatae* Pojark. ex T. T. Yu from *Spiraea* sect. *Chamaedryon*, i.e., the group of several mostly Chinese species not known from Taiwan according to the above-mentioned Chinese floras. However, recently, during the compilation of a Red Data Book for endangered and threatened plants of Taiwan, one previously published species, *S. tatakaensis* I. S. Chen, was unexpectedly found described and illustrated thoroughly in a Chinese journal (Chen, 1978) not familiar to the taxonomists. Thus this taxon has been overlooked by previous botanists and could not be found in any works on the flora of Taiwan or China. The careful morphological comparison reveals that the above-mentioned shrub found by the present author is conspecific with *S. tatakaensis*. Because the protologue of this species is not easily available, the accurate description (compiled from *R. Businský 66401* and the original description and illustration) and the new illustration are given here.

Spiraea tatakaensis I. S. Chen, Formosan Sci. 32(3): 53. 1978. TYPE: Taiwan. Tataka, Mt. Yuishan, 19 June 1977, *I. S. Chen 5129* (holotype, TAIF not seen) Figure 3.

Shrubs to ca. 1 m tall, with relatively slender, terete, straight branches and shoots; long shoots densely grayish tomentose initially, beginning cracking and peeling in lower mature part at end of the first year; buds ovoid to obtusely conical, 1–2 mm, shorter than petiole, with several scales pilose on exterior surface initially, at least along margin later. Leaves coriaceous; deep green, finely rugose, with immersed veins, and sparsely sericeous adaxially; glaucous, distinctly papillose, with fine, contrasting venation, and laxly sericeous abaxially, with hairs more dense on prominent principal veins and on revolute margin; leaf blades angular-obovate to narrowly obovate, 1.5–3.5× longer than wide, narrowly cuneate proximally but often obtuse at very base, (15–)20–30(–35) × 7–17 mm; margin with 3 or 4 pairs of decreasing, incised, forward-pointed, coarse, acute teeth in upper half on sterile long shoots or usually with only 2 tooth pairs in upper third of narrower leaves on short fertile branchlets or in lower part of sterile long shoots; lower pair of largest teeth in broader leaves often in form of indistinct lateral lobes with 1 to 3 outer, minute, serrate teeth; apex of blade acute; venation pinnate with usually 3 pairs of lateral veins leading to teeth apex, midvein and lateral veins raised abaxially; petioles 2–3 mm, with dense, long, sericeous hairs. Inflorescences seeming umbels on lateral, slender, leafy, 1–4 cm branchlets, with ca. 10 to 15 flowers, each always singly on slender, villous, ca. 1 cm pedicel. Hypanthium pubescent on both surfaces; sepals triangular, ca. 1 mm, externally glabrous, inside pubescent, spreading; petals white, suborbicular, 2–3 × ca. 3 mm, slightly emarginate; stamens ca. 20, shorter than petals, with filaments ca. 1.5–2 mm; carpels with long hairs inside and distally, style glabrous, ca. 1.5 mm. Follicles initially erect, ca. 2.5 mm, sparsely hairy chiefly along ventral suture near style insertion.

Habitat and distribution. *Spiraea tatakaensis* occurs on sunny forest margins or sparse woody slopes on slate or silicate ground, mostly between 1200 and 3200 m, often among trees of *Pinus taiwanensis* Hayata. Known only from one area in the central mountain range of Taiwan, particularly around the highest massif Yushan (Mt. Jade, 3952 m), *S. tatakaensis* is documented from the western and northeastern sides near the border of Chiayi and Nantou counties, and from a locality in Tanta valley ca. 35 km north-northeast of Mt. Yushan, in Nantou County.

IUCN Red List category. Least Concern (LC; IUCN, 2001).

Phenology. *Spiraea tatakaensis* flowers mostly in May to July.

Notes. The five cited collections of *Spiraea tatakaensis* at TAI and TAIF were incorrectly determined as *S. tarokoensis* and were also misidentified in the appendix to the new *Flora of Taiwan* treatment (Ohashi & Hsieh, 1993: photo 12), listing the former species under the name of the latter. *Spiraea tarokoensis* is locally endemic, known only from one limited area above the eastern coast of Taiwan, where it occurs at relatively low elevations. This rare species is inexactly described in the literature. According to Yu and Kuan (1963) and Yu and Lu (1974), *S. tarokoensis* is placed within the series *Mediae* Pojark. ex T. T. Yu, vaguely circumscribed from series *Trilobatae* (in which *S. tatakaensis* should be placed), based chiefly on the character of stamens shorter or subequal to petals versus stamens longer or slightly shorter than petals in the former. Although *S. tarokoensis* can be classified into the same group of seemingly umbellate species as *S. tatakaensis*, both species are quite dissimilar to each other, morphologically and also ecologically; *S. tatakaensis* is compared to *S.*

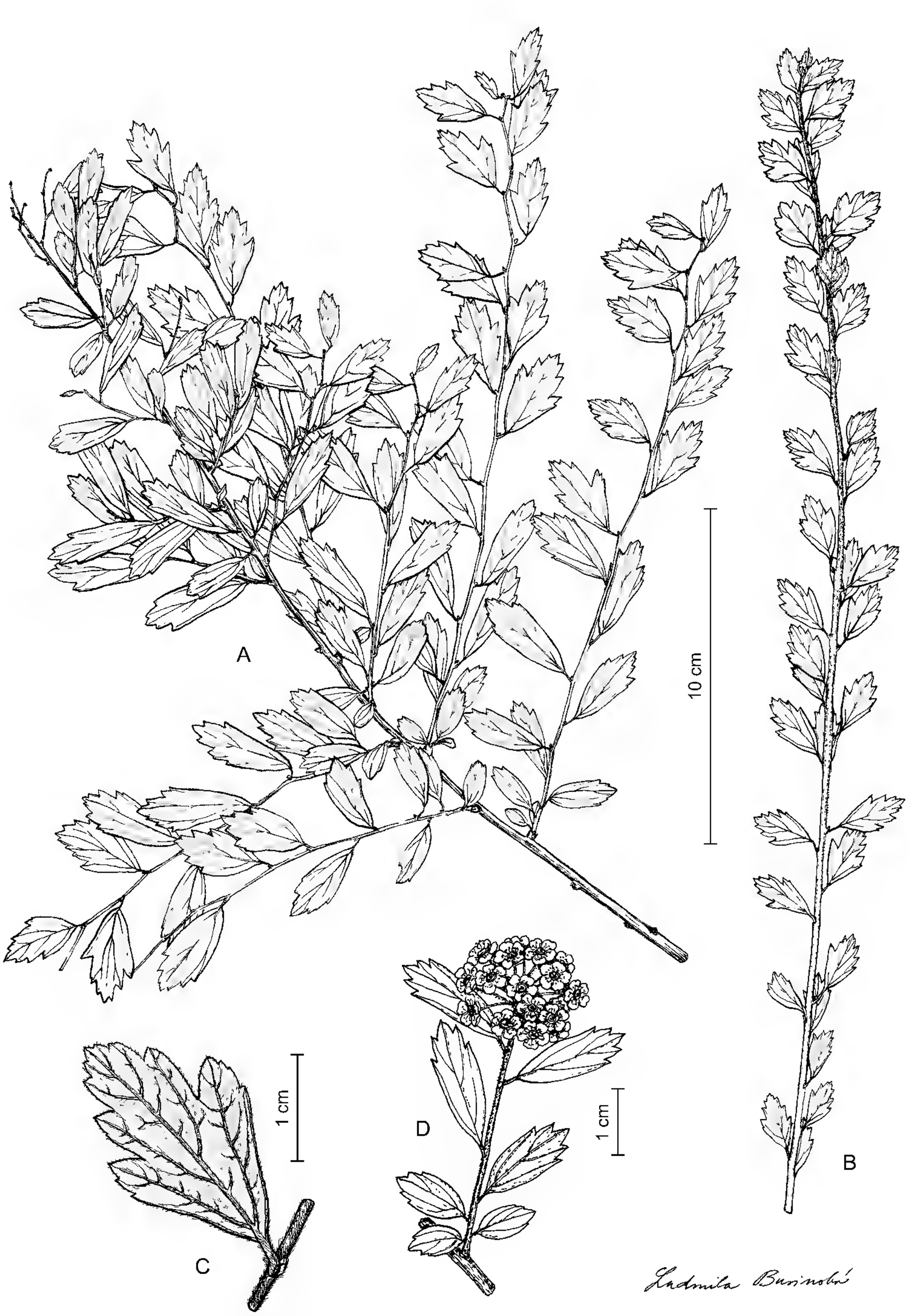


Figure 3. *Spiraea tatakaensis* I. S. Chen. —A. Branch in autumn of second year with fertile short branchlets in the terminal part after pedicels fell off. —B. Sterile long shoot. —C. Fully developed leaf of sterile long shoot, abaxial view. —D. Short branchlet with inflorescence. Drawn by Ludmila Businská, parts A–C from November collection, *R. Businský 66401* (G), D from *Sheng-You Lu 14766* (TAIF), both from the type locality.

tarokoensis and other seemingly umbellate species in Table 1. There are several discrepancies concerning *S. tarokoensis* in the *Flora of China* treatment (Lu & Crinan, 2003) and in Taiwanese floras (Li, 1963; Liu & Su, 1977; Ohashi & Hsieh, 1993). The illustration in the new *Flora of Taiwan* treatment (Ohashi & Hsieh, 1993: 156, pl. 71) is ascribed to *S. tarokoensis*, but is clearly not this species. Rather, plate 71 is certainly a drawing of *S. prunifolia*, approximately corresponding to *S. prunifolia* var. *pseudoprunifolia* (Hayata ex Nakai) H. L. Li. There is a second drawing of allegedly the latter taxon (but illustrated incorrectly with pubescent follicles) on the preceding plate 70 (Ohashi & Hsieh, 1993: 153). Given this confusion, an accurate description and the first illustration of *S. tarokoensis* correctly ascribed are given here, with both based on our collected material and the type.

Selected specimens. TAIWAN. **Nantou Co.:** Tong Puh Mt. Morrison [Yushan], *Ih-Sheng Chen 3750* (TAI); Sinyihsian, Dandalindao [Tanta valley], *Aleck T. Y. Yang et al. 6038* (TAI); Loloku Kuankao, *S. F. Huang 5273* (TAI). **Chiayi Co.:** [betw.] Tatachia [Tataka] & Paiyun Shelter, *Sheng-You Lu 14766* (TAIF); en route to Yushan, *T. C. Huang et al. 14253* (TAI); Yushan Natl. Park, Yushan (Mt. Jade) massif, S slopes of Mt. Jade Front Peak (3239 m), along path from Tataka (Paiyun) visitor center to Paiyun Lodge, *R. Businský 66401* [*Spiraea abscondita* Businský, nom. inval., in sched.] (G, RILOG herbarium).

Spiraea tarokoensis Hayata, Icon. Pl. Formosan. 9: 38–39. [25 Mar.] 1920. TYPE: Taiwan. Hualien, Taroko, 27 Apr. 1917, *B. Hayata & S. Sasaki s.n.* (types, TI [2]). Figure 4.

Lax shrubs to ca. 1 m tall, with relatively slender branches; shoots basically terete, with slender longitudinal ridges and soon cracking and peeling surface, villous-tomentose initially; buds globose to ovoid, with many keeled, villous scales, often sprouting in vigorous long shoots and also in fertile branchlets into lateral summer shoots (usually longer than bearing fertile branchlets). Leaves pale green, almost glabrous and with not immersed veins adaxially, almost glabrous, glaucous and papillose abaxially, with revolute margin; venation reticulate, contrasting and on principal veins pubescent abaxially; leaf blades on sterile long shoots usually ovate to suborbicular, sometimes rhombic-ovate, 1.2–2× longer than wide, with rounded or broadly rounded cuneate base, (8–)12–25 × (7–)10–20 mm, shallowly 3-lobed or coarsely crenate mostly only in upper half, with lobes or teeth ± obtuse, usually secondarily crenate, and with obtuse to rounded apex; venation consists of 3 principal veins sparsely branched upward, leading to teeth apex, raised abaxially; petioles 1.5–5 mm, villous; leaf blades on short fertile branchlets obovate, elliptic, or ovate, 7–16 mm, crenate or crenate to 3-lobed in upper third. Inflorescences seeming umbels on lateral, slender, leafy, 0.5–2.5(–5) cm, villous-tomentose branchlets, with 8 to 20 flowers, each always singly on slender, villous, 4–12 mm pedicel. Hypanthium and sepals villous on both surfaces; hypanthium shallowly funnel-shaped; sepals triangular with acute apex, 0.7–1.3 mm, spreading to reflexed; petals transversally obovate, emarginate, ca. 2 × 3 mm; stamens shorter than petals. Follicles suberect, 1.7–2.4 mm, with long hairs particularly on dorsal side; styles ca. 0.7–1.3 mm, dorsal, erect-spreading.

Habitat and distribution. *Spiraea tarokoensis* occurs on open limestone rocks or rocky sites between 400 and 1300 m. It is known only from the limited limestone area around Tienhsiang above Taroko gorge on the Pacific side of Taiwan's central mountain range, northwest of Hualien.

IUCN Red List category. *Spiraea tarokoensis* is certainly one of the rarest *Spiraea* species in the world. The difficult accessibility of rocky sites harboring the taxon is the most favorable factor in protecting it. However, a real risk for this species can be caused by wildfires or by construction or widening of roads (the population sampled by the present author at 950 m in 1991 was not found in 2008 due to road erosion and built-up protection). Therefore, this taxon is considered Vulnerable (VU) according to IUCN Red List criteria (IUCN, 2001).

Phenology. This species has been collected in flower in April to May.

Selected specimens. TAIWAN. **Hualien Co.:** Nai-taroko [Taroko Natl. Park], Kwarenko, *B. Hayata & S. Sasaki 68* (TAIF 12535, 12536 [s.n.], 12537); [Taroko Natl. Park] Yenhai logging trail, *Shih-Wen Chung 8006* (TAIF), *Pi-Fong Lu 9695* (TAIF); Taroko Natl. Park, limestone rocks of NE exposure along Central Cross-Island Hwy. near view above Tienhsiang (Tiansiang) ca. 1 km E of Hsipo hamlet, *R. Businský 32407* (G, RILOG herbarium).

Taxonomic Changes in *Spiraea* for *Flora of China*

Three taxa accepted in the *Flora of China* treatment (Lu & Crinan, 2003) as independent species are taxonomically changed here, either replaced in Chinese floras by a neglected taxon with a newly distinguished variety, synonymized, or relegated to the lower rank. Several new synonyms are also given.

Table 1. Comparison of *Spiraea tatakaensis* and *S. tarokoensis* from Taiwan with similar seemingly umbellate species occurring in mainland China.

Character	*S. tatakaensis*	*S. tarokoensis*	*S. siccanea*	*S. nishimurae*
Shoot indumentum (initial)	densely grayish tomentose	villous-tomentose	pubescent	pubescent
Leaf blade surfaces	deep green adaxially; glaucous, distinctly papillose, with contrasting venation, and laxly sericeous abaxially	pale green adaxially; almost glabrous and only on principal veins pubescent, glaucous and papillose abaxially	deep green adaxially; almost glabrous or only on principal veins pubescent and gray-green abaxially	light green on both surfaces; sparsely pubescent and without contrasting venation and papillae abaxially
Leaf blades on sterile long shoots				
Length, cm	mostly 2–3	mostly 1–2.5	1–2.5	mostly 1–2
Shape	angular-obovate to narrowly obovate, 1.5–3.5× longer than wide	ovate to suborbicular, 1.2–2× longer than wide	obovate or oblong	mostly rhombic-ovate to elliptic
Base	narrowly cuneate	rounded or broadly rounded cuneate	broadly cuneate to subrounded	narrowly cuneate
Margin	with 3 or 4 pairs of decreasing, coarse, acute teeth in upper 1/2	shallowly 3-lobed or coarsely crenate in upper 1/2, with lobes or teeth ± obtuse, secondarily crenate	shallowly 3-lobed and crenate above middle	with 2 or 3 pairs of coarse, secondarily serrate teeth or lobes in upper 2/3
Petioles				
Length, mm	2–3	1.5–5	2–5	1–3
Indumentum	dense, long, sericeous hairs	villous	sparsely pubescent or glabrous	sparsely pubescent
Inflorescences	ca. 10- to 15-flowered	8- to 20-flowered	mostly 7- to 15-flowered	7- to 25-flowered
Pedicels				
Length, mm	ca. 10	4–12	7–10	6–10
Indumentum	villous	villous	densely pubescent	sparsely pubescent
Distribution	central Taiwan	eastern Taiwan	northwestern Yunnan	north-central to northeastern China

1. Spiraea lasiocarpa Kar. & Kir., Bull. Soc. Imp. Naturalistes Moscou 15: 536. 1842. TYPE: [Kazakhstan.] "Dzhungaria, ad fl. Sarkan," s.d., *G. S. Karelin 1441* (holotype, LE).

1a. Spiraea lasiocarpa var. **lasiocarpa**.

Spiraea mongolica Maxim., Bull. Acad. Imp. Sci. St.-Pétersbourg 27: 467. 1881. Basionym: *Spiraea crenifolia* C. A. Mey. γ *mongolica* Maxim., Acta Horti Petropol. 6: 181. 1879. TYPE: [China.] "Mongolia occid., Terra Ordos [western Nei Mongol], montibus Alaschan [Helan Shan], pars media declivit. occid.," 18 June 1873, *Przewalski 295* (holotype, LE; isotype, PE).

Spiraea mongolica Maxim. var. *tomentulosa* T. T. Yu, Acta Phytotax. Sin. 8(3): 216. 1963, syn. nov. TYPE: China. [Nei Mongol:] "Mongolia Interiora, Mt. Ala, in rupibus siccis, 1500 1700 m," Aug. 1933, *W. Y. Hsia 3893* (holotype, PE).

Spiraea mongolica Maxim. var. *pubescens* Y. Z. Zhao & T. J. Wang, Bull. Bot. Res., Harbin 20(3): 259. 2000, syn. nov. TYPE: China. Xinjiang: [Ili Pref.], Zhaosu [43°09′N, 81°07′E], s.d., *Xinjiang exped. 10530* (holotype, PE).

Notes. The names *Spiraea mongolica* Koehne (Koehne, 1893: 212) and *S. gemmata* Zabel (Zabel, 1893: 23) are referred to the autonymic variety of *S. lasiocarpa*. Both Koehne's and Zabel's names require nomenclatural investigation.

1b. Spiraea lasiocarpa var. **villosa** Businský, var. nov. TYPE: China. Sichuan: Garze Pref., Dawu Xian, Dawu, foot of steep NE slopes above right bank of Xianshui He river SW opposite to town, grassy slope on limestone ground, 3100 m, 30°59′N, 101°07′E, 1 June 1992, *R. Businský 33403* (holotype, G; isotype, RILOG herbarium).

A varietate typica ramis novellis gemmis pedunculis et pedicellis villoso-tomentosis, foliis utrinque aequaliter villosis, hypanthiis et item sepalis extus villosis differt.

Table 1. Extended.

S. pubescens	*S. hirsuta*	*S. dasyantha*	*S. yunnanensis*
pubescent	pubescent	densely grayish tomentose	densely grayish tomentose
pubescent on both surfaces, not papillose abaxially	deep green adaxially; only sparsely pubescent abaxially intially	deep green adaxially; densely whitish tomentose abaxially	deep green adaxially; densely gray tomentose abaxially
2–6 rhombic-ovate to elliptic	2.5–6.5 obovate, rhombic-ovate, or elliptic	1.5–4.5 rhombic-ovate, 1.1–1.8× longer than wide	1–3.5 ovate, suborbicular, or obovate
narrowly cuneate or rounded cuneate with irregular coarse, sometimes secondarily serrate teeth, or shallow lobes in upper 1/2 or 2/3	narrowly to broadly cuneate or rounded cuneate serrate or serrate-lobed in upper 1/2 or 2/3	broadly cuneate to subcordate with 3 to 5 pairs of secondarily serrate teeth or lobes except base	broadly cuneate, rounded to subcordate shallowly crenate to incised obtusely lobed except base, secondarily serrate
2–6 pubescent	5–10 pubescent	2–5 densely tomentose	1–6 densely tomentose
15- to 40-flowered	> 20-flowered	10- to 25-flowered	5- to 30-flowered
5–15 glabrous or glabrescent	mostly 10–20 densely pubescent	6–10 densely gray tomentose	3–10 densely gray tomentose
central to northeastern China; Mongolia, Russia, Korea	central to southeastern China	central to eastern China	Yunnan and western Sichuan

This variety differs from *Spiraea lasiocarpa* var. *lasiocarpa* by the shoots and buds villous-tomentose (vs. mostly glabrous or pubescent in the autonymic variety), by the leaves including petioles ± densely villous equally on both blade surfaces including margin (vs. blades entirely glabrous or puberulous along usually lower margin portions), by corymbs with the peduncle and pedicels villous-tomentose (vs. entirely glabrous), and by the hypanthium and sepals villous externally (vs. glabrous).

Notes. *Spiraea lasiocarpa* was described from the Dzhungarskij Alatau Mountains (today's eastern Kazakhstan) from a locality close to the present Chinese border. It has been missing in important dendrological or specialized works (Zabel, 1893; Schneider, 1905; Rehder, 1927, 1940; Bean, 1981), or in Chinese floras (Yu & Lu, 1974; Lu & Crinan, 2003), but known from Russian literature (e.g., Pojarkova, 1939; Shul'gina, 1954; Svjazeva, 1980) and later known from floras of Pakistan (Stewart, 1972) and India (Purohit & Panigrahi, 1991). The autonymic variety representing the species was found to be taxonomically identical with *S. mongolica* Maxim. (Businský & Businská, 2002: 21), described from what is today the Chinese province of Nei Mongol, and as presented in Chinese floras (Yu & Lu, 1974; Fu & Hong, 2003; Lu & Crinan, 2003). *Spiraea gemmata* Zabel, another taxon conspecific with *S. lasiocarpa*, now to its autonymic variety, was described from cultivated plants of northern Chinese origin (Businský & Businská, 2002: 28), and this name has previously been used often in the literature (Schneider, 1905; Rehder, 1913, 1927, 1940; Bean, 1981; Maxwell & Knees, 1995) for the relevant Chinese plants. The correct name for this species widely distributed from Central Asia and the northwestern Himalayas to north-central China is *S. lasiocarpa*, by its nomenclatural priority. None of the

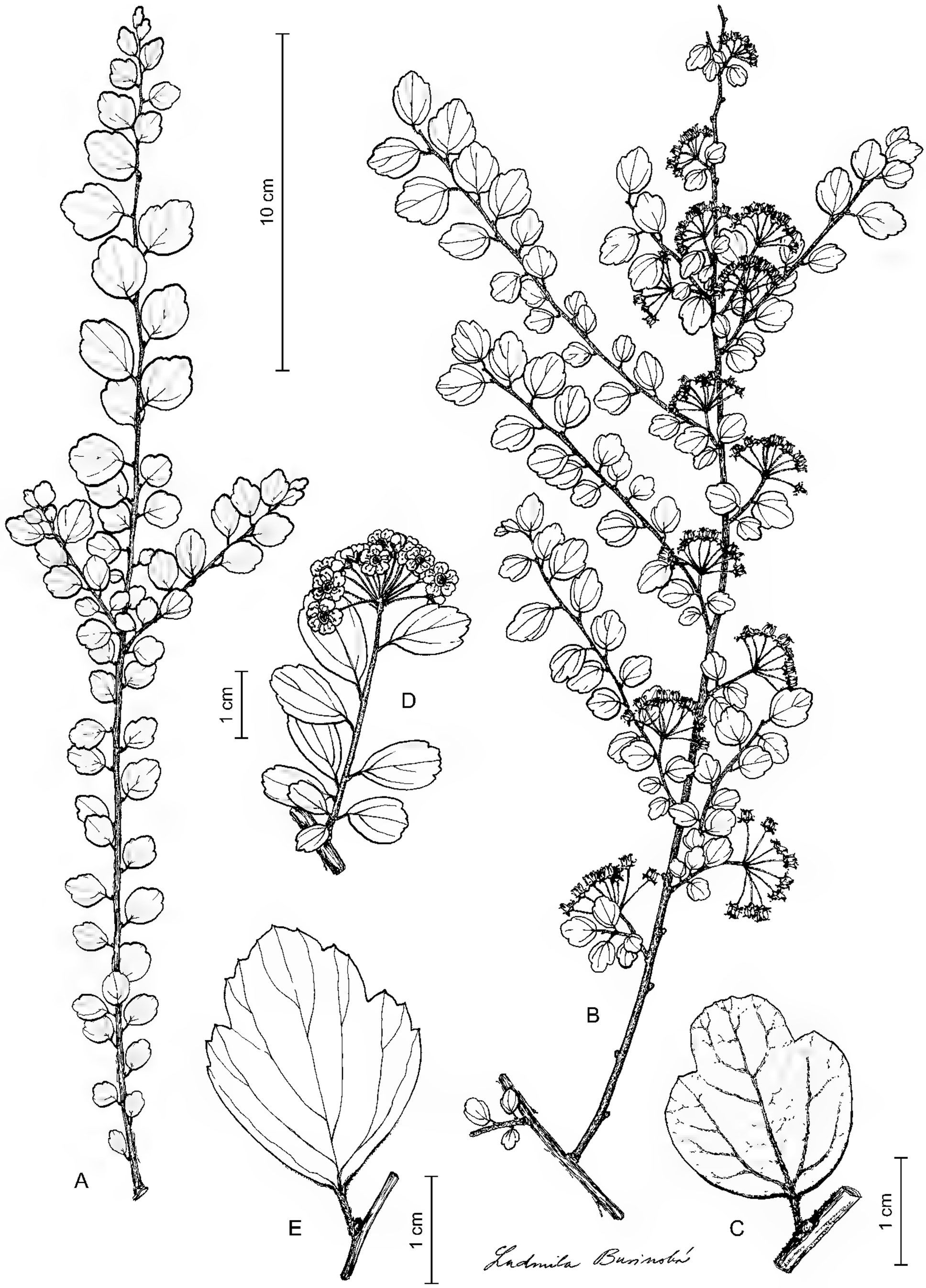


Figure 4. *Spiraea tarokoensis* Hayata. —A. Sterile long shoot with secondary lateral summer shoots. —B. Fertile branch with three-year basal portion and summer shoots grown laterally from bearing short fertile branchlets. —C. Fully developed leaf of sterile long shoot, abaxial view. —D. Short branchlet with inflorescence. —E. Fully developed leaf of sterile long shoot, adaxial view. Drawn by Ludmila Businská, parts A–C from December collection, *R. Businský 32407* (G), at the type locality; D and E from the type, *B. Hayata & S. Sasaki s.n.* (TI).

mentioned taxa are reported from the neighboring Mongolia (Grubov, 1982). The indumentum of *S. lasiocarpa* (including the follicles) varies from entirely glabrous morphotypes to wholly villous ones. Whereas the typical form is close to the first and glabrous extreme, the second one can be accepted at the rank of variety as newly described below. The taxa described as *S. mongolica* var. *tomentulosa* and *S. mongolica* var. *pubescens* represent not marked forms within the range of indumentum variation of *S. lasiocarpa* and are more closely affined to the typical form, therefore they are accepted as new synonyms for variety *lasiocarpa*. The opinion that *S. mongolica* var. *tomentulosa* and *S. ningshiaensis* T. T. Yu & L. T. Lu are conspecific (Zhao & Wang, 2000) is neither accepted in the *Flora of China* treatment (Lu & Crinan, 2003), nor here, because these taxa have a wholly different morphology in their winter buds (cf. the following key).

2. Spiraea muliensis T. T. Yu & L. T. Lu, Acta Phytotax. Sin. 13(1): 101. 1975. TYPE: China. Sichuan: Muli, Mengdong Shan, 2700 m, 21 June 1960, *Ying Jun-Sheng 4102* (holotype, PE).

Spiraea daochengensis L. T. Lu, Bull. Bot. Res., Harbin 9(2): 49. 1989, syn. nov. TYPE: China. Sichuan: Daocheng, 3800 m, 1 Sep. 1981, *Qing-Zang Exped. 5947* (holotype, PE).

Notes. These two imperfectly known taxa from southwestern Sichuan were accepted as separate species in the *Flora of China* treatment (Lu & Crinan, 2003). However, they are now found to be conspecific after careful comparison of both holotypes, as well as based on a study of the species variation at the newly found locality specified below. The holotype of *Spiraea daochengensis* represents a form with sparser indumentum on shoots, buds, both leaf blade surfaces, pedicels, and hypanthia including sepals externally, whereas the holotype of *S. muliensis* has all mentioned element surfaces densely villous.

Specimen collected. CHINA. **Sichuan:** Garze Pref., Jiulong Xian, bottom of upper Taka He valley, 3300 m, 29°01′N, 101°49′E, 5 July 2001, *R. Businský 51405* (G, RILOG herbarium).

3. Spiraea media Schmidt, Österr. Allg. Baumz. 1: 53, t. 54. 1792. TYPE: [Russia, West Siberia.] "Sibiria occid., prope fl. Irtys," 1733–1736, *J. G. Gmelin s.n.* (type, LE not seen).

Spiraea oblongifolia Waldst. & Kit., Descr. Icon. Pl. Hung. 3: 261, t. 235. 1812. TYPE: [Hungary.] "Spiraea oblongifolia Metsekensis ex horto," s.d., *P. Kitaibel s.n.* (lectotype, designated by Kováts [1992: 50], BP).

Notes. The name *Spiraea confusa* Regel & Körn, published in 1857, has been used in the older literature (e.g., Rehder, 1927; Pojarkova, 1939), but no type was designated. The name is referred to the autonymic variety of *S. media*.

3a. Spiraea media var. **media**.

3b. Spiraea media var. **sericea** (Turcz.) Maxim., Acta Hort. Petrop. 6: 189. 1879. Basionym: *Spiraea sericea* Turcz., Bull. Soc. Imp. Naturalistes Moscou 16: 591. 1843. TYPE: [Russia (Chita Province) & China (NE Nei Mongol) border.] "Dahuria, in lapidosis ad fluvium Argun," s.d., *N. S. Turczaninow s.n.* (type, LE).

Notes. *Spiraea sericea* was accepted in Russian literature (e.g., Pojarkova, 1939; Shul'gina, 1954; Svjazeva, 1980) and in Chinese floras (Yu & Lu, 1974; Lu & Crinan, 2003; Fu & Hong, 2003); it differs from typical *S. media* only by leaf blades laxly sericeous abaxially and initially pilose adaxially (vs. blades glabrous or almost glabrous in *S. media* var. *media*). Because the former taxon falls within the range of morphological variation and also geographical distribution of the latter, the former is accepted here only in the rank of variety.

Key to the Chinese Species of *Spiraea*

The following key contains all Chinese species accepted by the author for the genus *Spiraea* with lateral, simple inflorescences (with 1-flowered pedicels), usually classified into the two sections, *Spiraea* sect. *Glomeratae* and *Spiraea* sect. *Chamaedryon*. This taxonomic key substitutes for the corresponding portion in the *Flora of China* treatment (Lu & Crinan, 2003: 49–50, key leads 30–70), where several discrepancies were found. The crucial diagnostic character of the inflorescences as compound versus simple, is missing in the lead couplet (1) in the *Flora of China* key. Alternative constructions of some leads, believed more useful for determination, were compiled for the key presented here, which also excludes other less reliable characters previously used. Significant synonyms are given in parentheses in the key. Altogether, 40 species of *Spiraea* and one interspecific hybrid are included in the following key.

KEY TO THE CHINESE SPECIES OF *SPIRAEA* WITH SIMPLE INFLORESCENCES

1a. Inflorescences terminal or lateral, always compound, with branched pedicels ..... [28 Chinese species outside this study]

1b. Inflorescences always lateral, simple, with unbranched, 1-flowered pedicels (rarely some lower pedicels poorly branched).

2a. Flowers in sessile fascicles or shortly pedunculate (subsessile) crowded together corymbs, only with basal leaf rosette (*Spiraea* sect. *Glomeratae*).

3a. Leaves heteromorphic, those on sterile long shoots usually distinctly lobed or at least coarsely crenate-serrate, those in basal rosettes under inflorescences not lobed, entire.

4a. Long shoots and branchlets conspicuously angled, dark reddish brown initially ... *S. calcicola* W. W. Sm.

4b. Long shoots and branchlets terete, pale brown initially.

5a. Leaf blades glabrous on both surfaces.

6a. Long shoots entirely glabrous; leaf blades on sterile long shoots broadly angular-obovate to transversally rounded rhombic, mostly 3-lobed, 3-veined, conspicuously grayish pruinose, with contrasting venation abaxially ..... *S. adiantoides*

6b. Long shoots pubescent or puberulent initially; leaf blades on sterile long shoots obovate, elliptic, or suborbicular, mostly not lobed, usually pinnately veined, pale green or glaucous green and usually without contrasting venation abaxially .... *S. kwangsiensis* T. T. Yu

5b. Leaf blades densely pubescent or tomentose abaxially.

7a. Leaf blades on sterile long shoots mostly < 12 mm, ± transversally obovate, flabellate, ± deeply 3- to 5-lobed ..... *S. aquilegiifolia* Pall.

7b. Leaf blades on sterile long shoots mostly > 12 mm, broadly ovate, obovate, or elliptic to suborbicular, coarsely crenate or shallowly 3-lobed, often secondarily crenate.

8a. Shoots tomentose; leaf blade often 3-lobed, with a few coarse, obtuse teeth above middle ..... *S. martini* H. Lév.

8b. Shoots pubescent; leaf blade not lobed, with many coarse, crenate teeth above base ..... *S. cavaleriei* H. Lév.

3b. Leaves homomorphic, those on sterile long shoots similar in shape to those in basal rosettes below inflorescences (disregarding numbers in serration or teeth).

9a. Leaf blades entire or at most with 2 to 4 coarse teeth near apex; long shoots and branchlets terete.

10a. Shoots glabrous or puberulent initially; leaf blades usually 15 20 mm; follicles glabrous.. ..... *S. hypericifolia* L.

10b. Shoots ± densely pubescent initially; leaf blades shorter than 15 mm; follicles pubescent ..... *S. chailarensis* Liou (including *S. arenaria* Y. Z. Zhao & T. J. Wang)

9b. Leaf blades sharply serrate at least above middle (when only near apex then serration minute); long shoots and branchlets ± angled.

11a. Leaf blades linear-lanceolate, glabrous on both surfaces ..... *S. thunbergii* Siebold ex Blume

11b. Leaf blades oblong, elliptic, or ovate, usually pubescent or villous on both or at least one surface.

12a. Leaf blades minutely serrate; long shoots and branchlets slightly angled; pedicels > 10 mm ..... *S. prunifolia*

12b. Leaf blades coarsely serrate; long shoots and branchlets conspicuously angled; pedicels < 10 mm ..... *S. muliensis*

2b. Flowers in corymbs, racemose corymbs, or seeming umbels, all on a peduncle continuing to leafy short branchlet (*Spiraea* sect. *Chamaedryon*, s. str.).

13a. Winter buds with 2 exterior valvate scales with acuminate apex (cf. Note 1).

14a. Leaf blades sharply serrate; stamens longer than petals; sepals reflexed in fruit.

15a. Leaf blades lanceolate, oblong-elliptic, or oblong-ovate, margin simply serrate above middle or only near apex; stamens ca. 20 ..... *S. flexuosa* Fisch. ex Cambess.

15b. Leaf blades broadly ovate, margin usually doubly serrate almost from base or above middle; stamens 35 to 50 ..... *S. chamaedryfolia* L.

14b. Leaf blades entire or apically crenate-serrate; stamens nearly equaling petals; sepals erect or spreading in fruit.

16a. Sterile shoots relatively long and slender; buds usually 2 5 mm; branchlets usually straight; leaf blades on sterile long shoots usually oblong-elliptic ..... *S. lasiocarpa*

16b. Sterile shoots relatively short and thick; buds usually 5 8 mm; branchlets arcuate; leaf blades on sterile long shoots ovate, elliptic, or obovate, rather broadly so..... ..... *S. mollifolia* Rehder (cf. Note 2)

13b. Winter buds with several exterior ± imbricate scales usually with obtuse or acute apex.

17a. Prostrate shrub; flowers in ± congested corymbs on a peduncle continuing to a very short branchlet with leaves almost crowded to basal rosette; (leaf blades broadly ovate, 0.8 1.5 × 0.5 1 cm, long sericeous on both surfaces)..... ..... *S. pjassetzkii* Buzunova (including *S. prostrata* Maxim., nom. illeg.)

17b. Erect shrub, although sometimes lax; short branchlets bearing inflorescence with leaves arranged at ± distinct intervals.

18a. Leaf blades usually < 8 mm wide and 2.5 5× longer than wide, entire, or sometimes with a few teeth near apex.
19a. Long shoots and branchlets terete, glabrous; sepals reflexed ... *S. dahurica* (Rupr.) Maxim.
19b. Long shoots and branchlets angled, pubescent initially; sepals erect or almost spreading.
20a. Leaves glabrous on both surfaces; petals white; follicles with subterminal, divergent styles ..... *S. alpina* Pall.
20b. Leaves pubescent on both surfaces; petals pinkish to purple-red; follicles with dorsal, suberect styles .....
... *S. xizangensis* L. T. Lu (including *S. tibetica* T. T. Yu & L. T. Lu, nom. illeg.)
18b. Leaf blades on sterile long shoots usually > 8 mm wide and < 2.5× longer than wide, crenate, serrate, lobed, or sometimes entire.
21a. Long shoots and branchlets angled.
22a. Leaf blades broadly ovate, often sparsely denticulate above middle, sometimes shallowly 3-lobed, 3-veined; inflorescences < 2 cm wide ..... *S. ningshiaensis*
22b. Leaf blades elliptic, elliptic-oblong, or obovate-oblong, entire or sometimes denticulate at apex, pinnately veined; inflorescences usually > 2 cm wide
..... *S. myrtilloides* Rehder
21b. Long shoots and branchlets terete or almost terete.
23a. Flowers in corymbs or racemose corymbs (pedicels ± distant on inflorescence axis); stamens at least slightly to ca. 2× longer than petals.
24a. Leaf blades entire or coarsely serrate at apex or at most in upper third
..... *S. media*
24b. Leaf blades simply or doubly, sometimes obtusely serrate, incised serrate or serrate lobed, at least above middle.
25a. Shoots, leaf blades abaxially, pedicels, hypanthia externally, and follicles pubescent; sepals erect in fruit ... *S. sublobata* Hand.-Mazz.
25b. Shoots, leaf blades abaxially, pedicels, and hypanthia externally usually glabrous or nearly so, follicles glabrous, sometimes pilose along ventral suture or throughout (*S. anomala* Batalin).
26a. Leaf blades oblong-elliptic, oblong-ovate, or lanceolate-elliptic, with base cuneate; sepals erect in fruit.....
..... *S. elegans* Pojark.
26b. Leaf blades ovate, triangular-ovate, elliptic-ovate, or broadly ovate, when lanceolate-ovate (sometimes in *S. anomala*) then with base truncate or subrounded; sepals usually reflexed or sometimes suberect in fruit.
27a. Corymbs 3- to 6-flowered, flowers 6 9 mm diam.; follicles hirsute throughout ..... *S. anomala*
27b. Corymbs 5- to 20-flowered, flowers 8 12 mm diam.; follicles glabrous or pilose along ventral suture.
28a. Leaf blades on sterile long shoots usually incised doubly serrate ..... *S. laeta* Rehder
28b. Leaf blades on sterile long shoots usually shallowly simply or doubly serrate.
29a. Leaf blades sericeous-villous on both surfaces, gray-green abaxially; inflorescences 12- to 20-flowered; flowers 8 10 mm diam. ..... *S. papillosa* Rehder
29b. Leaf blades glabrous on both surfaces, pale-green abaxially; inflorescences 5- to 10-flowered; flowers 10 12 mm diam..
..... *S. lichiangensis* W. W. Sm.
23b. Flowers in seeming umbels (pedicels densely crowded almost into one insertion point at apex of inflorescence axis); stamens shorter than or subequaling petals.
30a. Leaf blades glabrous or almost glabrous on both surfaces or puberulous on veins abaxially.
31a. Shoots pubescent or villous-tomentose initially.
32a. Shoots villous-tomentose initially, leaf petioles villous (eastern Taiwan) ..... *S. tarokoensis*
32b. Shoots pubescent initially, leaf petioles sparsely pubescent or glabrous (northwestern Yunnan) .....
..... *S. siccanea* (W. W. Sm.) Rehder
31b. Shoots glabrous from initiation.
33a. Leaf blades on sterile long shoots rhombic-lanceolate to rhombic-oblong, with base narrowly cuneate and apex acute
..... *S. cantoniensis* Lour.

33b. Leaf blades on sterile long shoots rhombic-ovate, rhombic-obovate, broadly ovate, or suborbicular, with base ± broadly cuneate (sometimes shortly narrowed toward petiole), rounded or subcordate, and apex obtuse or subacute.
34a. Leaf blades bluish gray abaxially; fruits often not developing or irregularly developing (cultivated plants of cultural origin) ..... *S.* ×*vanhouttei* (Briot) Carrière (— *S. cantoniensis* × *S. trilobata* L.)
34b. Leaf blades ± pale green abaxially; fruits usually well developing (natural species usually not cultivated except in experimental plantations).
35a. Leaf blades on sterile long shoots suborbicular, usually with 1 or 2 pairs of lateral lobes, base often rounded or subcordate ..... *S. trilobata* L.
35b. Leaf blades on sterile long shoots rhombic-ovate or ovate, often with 2 or 3 pairs of lateral lobes, base broadly cuneate ..... *S. blumei* G. Don (cf. Note 3)

30b. Leaf blades pubescent, sericeous, or tomentose throughout abaxial surface.
36a. Pedicels and hypanthia externally usually glabrous.
37a. Leaf blades on sterile long shoots narrowly elliptic to oblong-lanceolate, pubescent only abaxially ..... *S. cantoniensis* var. *jiangxiensis* (Z. X. Yu) L. T. Lu
37b. Leaf blades on sterile long shoots rhombic-ovate to elliptic, pubescent on both surfaces ..... *S. pubescens* Turcz.
36b. Pedicels and hypanthia externally pubescent to tomentose.
38a. Leaf blades pubescent or sericeous abaxially.
39a. Leaf blades light green on both surfaces, mostly 1 2 cm ..... *S. nishimurae* Kitag.
39b. Leaf blades deep green adaxially and glaucous abaxially, mostly 2 5 cm.
40a. Shoots pubescent initially; leaf blades sparsely pubescent abaxially initially, petioles 5–10 mm; inflorescences > 20-flowered ..... *S. hirsuta* (Hemsl.) C. K. Schneid. (cf. Note 4)
40b. Shoots densely tomentose initially; leaf blades laxly sericeous abaxially at all times, petioles 2 3 mm; inflorescences < 20-flowered ..... *S. tatakaensis*

38b. Leaf blades tomentose abaxially.
41a. Shoots initially and leaf blades abaxially yellowish or rusty yellow tomentose; sepals ovate-lanceolate ..... *S. chinensis* Maxim.
41b. Shoots initially and leaf blades abaxially grayish to whitish tomentose; sepals triangular to ovate-triangular.
42a. Leaf blades on sterile long shoots rhombic-ovate, serrate, doubly serrate to ± acutely lobed, with apex usually acute ..... *S. dasyantha* Bunge (cf. Note 4)
42b. Leaf blades on sterile long shoots broadly ovate, suborbicular, or obovate, shallowly crenate to incised obtusely lobed and secondarily serrate, with apex obtuse or rounded ... *S. yunnanensis* Franch.

Taxonomic Notes for Chinese *Spiraea*

Note 1. The character of exterior bud scales in *Spiraea*, i.e., two valvate scales versus several imbricate ones, has been noted as diagnostic in the literature (e.g., Rehder, 1913, 1927, 1940; Pojarkova, 1939; Yu & Kuan, 1963), occasionally interpreted as "outer scales longer versus shorter than the inner" (Ohwi, 1965: 519; Ikeda, 2001: 104). This character is reliable and stabilized to variable extent in *Spiraea* species. For instance, the state of two valvate bud scales is the conspicuous, stable character in *S. mollifolia*, but is not stable in *S. flexuosa* or *S. lichiangensis*. Reports for bud scales are quite confused for *S. miyabei* Koidz. (species with inflorescences compound), where the three known

Chinese varieties (var. *glabrata* Rehder, var. *tenuifolia* Rehder, var. *pilosula* Rehder) are reported to have small buds covered by several scales, whereas buds of the Japanese variety *miyabei* were observed with two distinctly long, acuminate, valvate scales (Businský & Businská, 2002). Generally speaking, the condition of bud scales is fully developed and the most distinct in mature winter buds, which are usually not present in herbarium specimens nor observed on plants during vegetation seasons. On the contrary, buds developing in the leaf axillae on immature shoots could be covered initially with valvate scales, which are ripped up later by the increasing bud with several imbricate scales.

Note 2. *Spiraea mollifolia* was studied by the present author in several populations from western Hubei (Dashennongjia massif) and southern Shaanxi (Qin Ling Mtns.) through western Sichuan and northwestern Yunnan to south-central Xizang (Lhasa environs). This species is easily recognized by its distinctive buds that are conspicuously long and narrow, as well as by the thick, angled shoots. However, it is also extremely variable in its indumentum, which varies from glabrous morphotypes to very densely villous ones, similarly and even more so than its sister *S. lasiocarpa*. For this reason, the indumentum characters used to discriminate these two species (the latter under the name *S. mongolica*) in the taxonomic key for the *Flora of China* treatment (Lu & Crinan, 2003) is not accepted here.

Note 3. *Spiraea alaschanica* Y.-Z. Zhao & T.-J. Wang (Bull. Bot. Res., Harbin 20[4]: 362. 2000) was described only from the type, *Ningxia Agric. College 60009* (holotype, NXAC), reported from Helan Shan (Ningxia, China), 23 May 1960. Because the original material is limited and not easily accessible, the identity of this taxon remains unresolved to date. In the *Flora of China* treatment (Lu & Crinan, 2003), it was mentioned as a problematic taxon only in the remark to *S. blumei* with which it was putatively related. According to the protologue (Wang & Zhao, 2000: 362), *S. alaschanica* corresponds with *S. blumei* except in the reported morphology of buds of the former "gemmae subulatae, biperulatae." However, this character was assessed by the describing authors from young, undeveloped buds on material collected at springtime, although the obviously young bud on the accompanying illustration was described as a winter bud. For the reason that this character is not reliable in some species and is fully distinct in mature winter buds (cf. Note 1), *S. alaschanica* is provisionally accepted here as a synonym to *S. blumei*.

Note 4. *Spiraea nervosa* Franch. & Sav. (Enum. Pl. Jap. 2: 331. 1878) was incorrectly given in Chinese floras (Yu & Lu, 1974; Lu & Crinan, 2003) as a synonym to the dissimilar *S. dasyantha* Bunge (Enum. Pl. Chin. Bor. 23. 1833). The former taxon is accepted as a Japanese endemic (Ikeda, 2001); however, its differences from the Chinese *S. hirsuta* (Bull. Herb. Boissier, ser. 2, 3: 342. 1905), examined on limited material and also from published characters, are insufficiently convincing, and these taxa could be conspecific. In this instance, the name of the Japanese taxon would have nomenclatural priority, but a more thorough comparative study is necessary.

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A New Species and One New Name in *Castanopsis* (Fagaceae) from Hainan, China

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ABSTRACT. A new species, *Castanopsis glabrifolia* J. Q. Li & Li Chen, and one new name, *C. hsiensiui* (X. M. Chen & B. P. Yu) J. Q. Li & Li Chen (Fagaceae), are described from Hainan, China. They both grow on sandy beaches. *Castanopsis glabrifolia* is closely related to *C. chinensis* (Spreng.) Hance, differing from it by having smaller leaves, shorter petioles, fewer secondary veins, and smaller cupules that are incompletely covered by shorter spines. *Castanopsis chinensis* var. *hainanica* X. M. Chen & B. P. Yu is treated as a new synonym of *C. glabrifolia*. The new name *C. hsiensiui* is proposed, based on *C. hainanensis* Merr. var. *litoralis* X. M. Chen & B. P. Yu, with the variety recognized at higher rank based on its glabrous branches and petioles, the smaller cupules with the external surfaces visible, and the nuts that are glabrous or sparsely pubescent near the apex.

Key words: *Castanopsis*, China, Fagaceae, Hainan, IUCN Red List.

In the first comprehensive revision of *Castanopsis* (D. Don) Spach (Fagaceae), Camus (1929) recorded 112 species with a taxonomic key and detailed descriptions of their respective morphology and anatomy. Her work was subsequently complemented by Barnett (1944), who recognized 119 species in 11 groups. Govaerts and Frodin's (1998) *World Checklist and Bibliography of Fagales* included 134 species of *Castanopsis*, with 61 or 62 species recorded for China. Most recently, Huang and Chang (1998) and Huang et al. (1999) revised Chinese *Castanopsis* and accepted 63 species and 58 species in the *Flora Reipublicae Popularis Sinicae* and *Flora of China* treatments, respectively. This increasing number of taxa in *Castanopsis* is mostly due to the descriptions of new species and transfers published in the past several decades (Fu & Huang, 1989; Huang & Chang, 1990, 1996; Chen & Yu, 1991; Fu & Feng, 1992; Fu, 2001; Chen et al., 2009, 2010). During revision of Chinese *Castanopsis*, we recognize 66 species of this genus in China, based on extensive examination of herbarium specimens and field investigation. In this paper, the following novelties are proposed.

1. Castanopsis glabrifolia J. Q. Li & Li Chen, sp. nov. TYPE: China. Hainan: Wenchang, Changmao of Daodong Forest Farm, Tiantou village, 14 Jan. 1978, *Anonymous 9254* (holotype, IBSC 0034559). Figure 1.

Castanopsis chinensis (Spreng.) Hance var. *hainanica* X. M. Chen & B. P. Yu, J. S. China Agric. Univ. 12: 93. 1991, syn. nov. TYPE: China. Hainan: Wenchang, 11 Dec. 1987, *B. P. Yu 103158* (holotype, CANT).

Species *Castanopsidi chinensi* (Spreng.) Hance affinis, sed ab ea foliis minoribus, petiolis brevioribus, nervis lateralibus utrinsecus paucioribus atque cupulis minoribus spinis brevioribus incomplete tectis differt.

Trees; second-year twig cortices gray, branches red-brown after cortices dehisce, lenticels slightly raised; first-year branches and rachis of infructescences red-brown; branches, leaves, and rachis of inflorescences glabrous. Young leaves dark when dry, abaxially with few dotted brown scales; petioles 0.9–1.5 cm, red-brown; leaves elliptic, rarely ovate, 3.5–8.5(–10) × 1.1–3(–4.5) cm, leathery and concolorous, bases cuneate, rarely rounded, margins with shallow to deep teeth, apex long acute; midvein from base to middle adaxially raised or flat, red-brown, secondary veins in 6 to 9 pairs on each side of midvein, adaxially flat. Rachis of infructescences 3.5–7 × 0.1–0.15 cm; cupule prolate ellipsoid, 1.1–1.7 cm diam., sometimes basally short-stalked, splitting into 2 to 3 segments when mature, cupule spines 2.5–5.5 mm, scattered or connate at base and transversely united across 3 or 4 rings, the external cupule and spines sparsely covered with gray pubescence and scales. Fruit as 1 nut per cupule, prolate ellipsoid, glabrous or sparsely pubescent near apex, ca. 1.2 × 0.6–0.8 cm, scar basal, slightly raised, 0.4–0.7 cm diam.

Distribution and habitat. *Castanopsis glabrifolia* has been collected from sandy beaches along the seashore of Wenchang County, Hainan.

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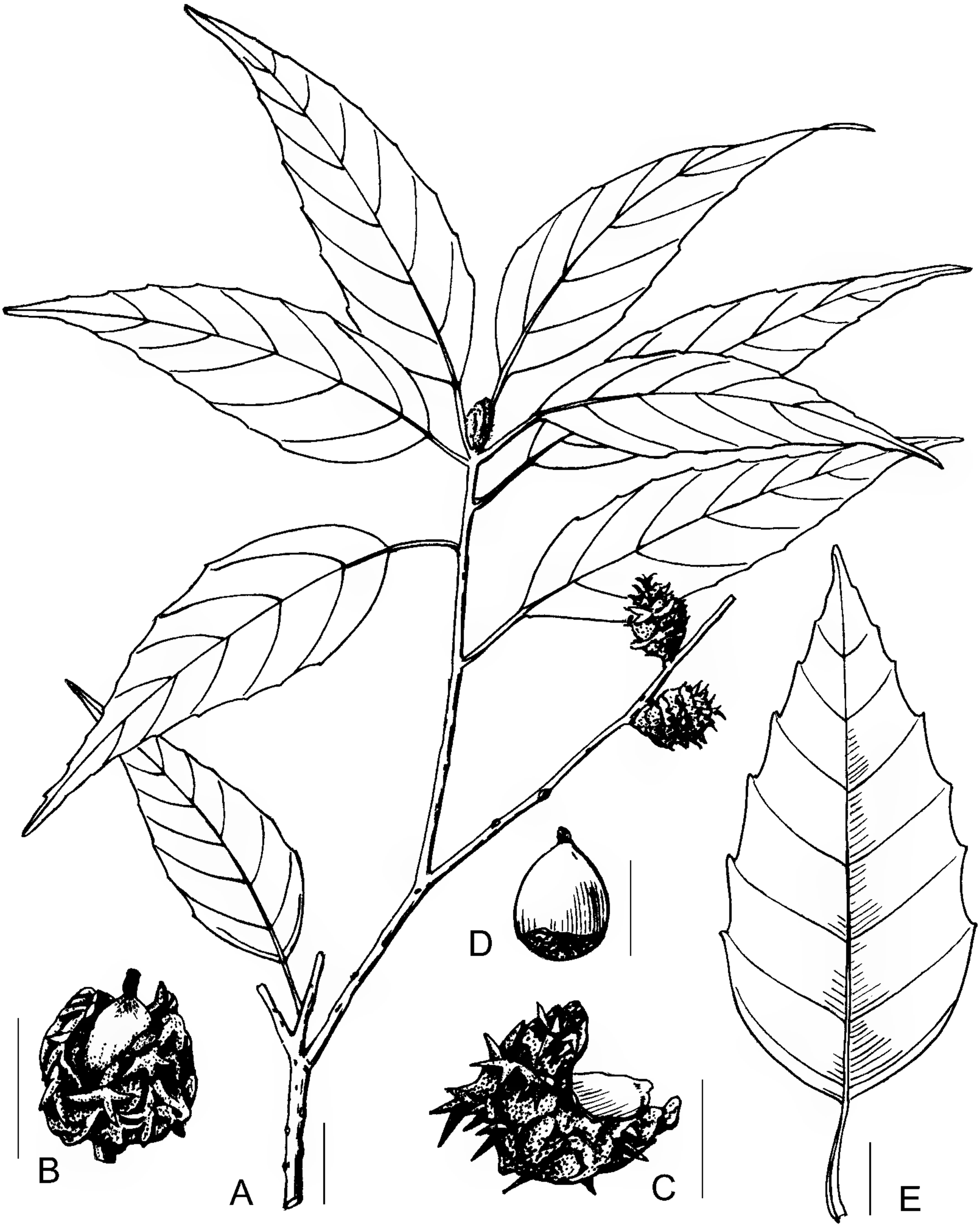

Figure 1. *Castanopsis glabrifolia* J. Q. Li & Li Chen. —A. Fertile branch. —B. Nut enclosed by spinose cupule. —C. Cupule. —D. Nut. —E. Leaf showing the variation of the leaf base. Scale bars — 1 cm. Figure drawn by Gexin Chen (Wuhan Botanical Garden, CAS) from *Anonymous 9254* (IBSC).

IUCN Red List category. *Castanopsis glabrifolia* is known from four populations from Wenchang County. The taxon should be categorized as Critically Endangered (CR) according to IUCN Red List Categories and Criteria (IUCN, 2001).

Etymology. The specific epithet *glabrifolia* is taken from the Latin and refers to the glabrous leaves of the new species.

Vernacular name. Gezhui, Gangzhui.

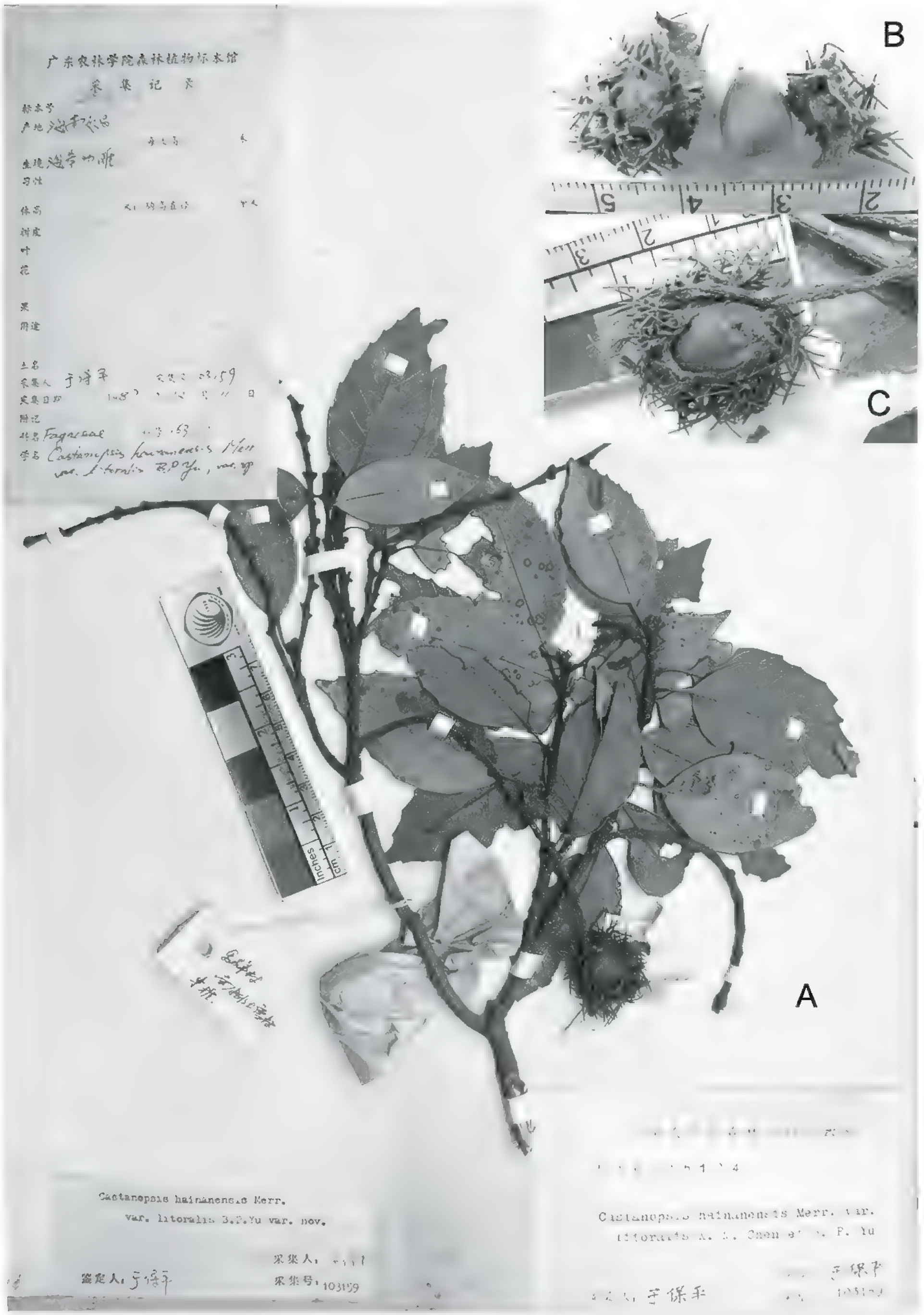

Figure 2. *Castanopsis hsiensiui* (X. M. Chen & B. P. Yu) J. Q. Li & Li Chen. —A. Fertile branch. —B. Nut dissected from cupule. —C. Nut enclosed by spinose cupule. The smallest division of the ruler in each image is 1 mm. Photos taken from the type *B. P. Yu 103159* (CANT).

Discussion. *Castanopsis glabrifolia* is similar to *C. chinensis* (Spreng.) Hance (TYPE: China. Canton [Guangdong]: Tsingyune, N River, *Sampson & Hance 13785*, holotype, BM) in its concolorous and glabrous leaves, but the new species is distinguished by its smaller leaves (3.5–8.5 × 1.1–3 cm vs. 7–18 × 2–5 cm in *C. chinensis*), shorter petioles (0.9–1.5 cm vs. 1.5–2 cm), fewer secondary veins (6 to 9 vs. 8 to 14

pairs), and smaller cupules (1–1.7 cm diam. vs. 2.5–4 cm diam.) that are incompletely covered by shorter spines (2.5–5.5 mm vs. 6–12 mm).

After carefully checking the holotype materials and the original description of *Castanopsis chinensis* var. *hainanica* (Chen & Yu, 1991), we determined that *C. glabrifolia* and this variety represent the same taxon. According to Art. 11.2 of the *International Code of Botanical Nomenclature* (McNeill et al., 2006), the epithet *hainanica* has no priority outside the varietal rank.

Paratypes. CHINA. **Hainan:** Wenchang, *J. Hsiao 137877* (IBSC), *137881* (IBSC), *B. P. Yu 103158* (CANT), *Anonymous 9242* (IBSC), *9252* (IBSC), *9253* (IBSC), *9254* (IBSC), *9255* (IBSC).

2. Castanopsis hsiensiui (X. M. Chen & B. P. Yu) J. Q. Li & Li Chen, nom. et stat. nov. Basionym: *Castanopsis hainanensis* Merr. var. *litoralis* X. M. Chen & B. P. Yu, J. S. China Agric. Univ. 12: 92. 1991. TYPE: China. Hainan: Wenchang, Changsa, Nanpaitang village, sandy beach, 11 Dec. 1987, *B. P. Yu 103159* (holotype, CANT). Figure 2.

Trees; first-year branches gray-black with slightly raised lenticels; branches glabrous. Petioles 1–1.6 cm; leaves broadly elliptic or elliptic, rarely ovate, 4.8–7.7 × 2.5–3.8 cm, leathery and concolorous, abaxially with tight, thin scales; bases broadly cuneate or cuneate, rarely subrounded, margins with shallow teeth at least from middle to apex, sometimes curled abaxially, apex short acute; midvein flat or slightly impressed at base adaxially, secondary veins in 8 or 9 pairs on each side of midvein, adaxially flat. Rachis of inflorescences gray pubescent; rachis of infructescences 7.5–11 × 0.15–0.2 cm. Cupules globose, 2.5–3 cm diam., cupule externally covered with sparse glabrous spines, spines 0.7–1.1 cm, connate at base to middle. Fruit as 1 nut per cupule, conical, glabrous or sparsely pubescent near apex, 1.2–1.7 × 0.8–1.3 cm, scar basal, ca. 0.7 cm diam.

Distribution and habitat. *Castanopsis hsiensiui* has been collected from sandy beaches along the seashore of Wenchang County, Hainan.

IUCN Red List category. *Castanopsis hsiensiui* is considered here as Data Deficient (DD) according to IUCN Red List Categories and Criteria (IUCN, 2001). The taxon is known only from a single collection, and more information about the number of individuals and the extent of the habitat is needed.

Etymology. The specific epithet honors botanist Hu Hsen-Hsu (1894–1968) for his pioneering research on Chinese botany.

Discussion. The most distinctive character of *Castanopsis hainanensis* Merr. (TYPE: China. Hainan: Qiongzhong, betw. Namfung & Hongmatsuen, 3 Dec. 1921, in thickets near villages, 400 m, *McClure 8300*, holotype, SYS) is that its branchlets, petioles, and young leaves are abaxially covered with thin, brown, very short felted pubescence and scales. In contrast, *C. hainanensis* var. *litoralis*, described by Chen and Yu (1991), is distinguished by its glabrous branches and petioles, and the leaves lack pubescence abaxially, with only a layer of tightly adherent, thin scales. Furthermore, the cupules of *C. hainanensis* are larger (4–5.7 cm diam.) and their external surfaces are completely covered by longer spines (1–1.9 cm vs. 0.7–1.1 cm in *C. hsiensiui*), in contrast with *C. hsiensiui*, which has smaller cupules (2.5–3 cm diam.) with the cupule surfaces externally visible. In addition, *C. hsiensiui* has glabrous nuts, or with the apex sparsely hairy, while nuts of *C. hainanensis* are pubescent. Based on these characters, *C. hainanensis* var. *litoralis* merits treatment at the rank of species rather than as a variety of *C. hainanensis*, and we recognize it here as *C. hsiensiui*.

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Inga pitmanii (Fabaceae), a New Species from Madre de Dios, Peru

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ABSTRACT. *Inga pitmanii* K. G. Dexter & T. D. Penn., a new species of *Inga* Mill. from Madre de Dios, Peru, is described for the Fabaceae (Mimosoideae). Morphologically it is closest to *I. chartacea* Poepp. & Endl., with which it shares a broadly winged rhachis, spicate inflorescence, glabrous leaves, nine to 10 pairs of secondary veins, and similar calyx indumentum. *Inga pitmanii* differs from *I. chartacea* in the leaflet number (four pairs vs. usually two or three pairs), the foliar nectaries (cyathiform vs. patelliform), and the larger flowers (with corollas 9–11.5 mm vs. 4.5–7 mm). Phylogenetic analyses show this species belongs to a clade including *I. acreana* Harms and *I. chartacea*. This species was discovered during field surveys for an ecological study of the genus *Inga* at the Los Amigos Biological Station in Madre de Dios, Peru. These field surveys uncovered several potentially novel species of the genus *Inga*, none of which matched any known species based on vegetative characters and the majority of which are genetically distinct. Here we describe *I. pitmanii* as this is the only species that was collected in a fertile state. Given current and future limitations in taxonomic expertise and funding, we advocate consideration of nonconventional approaches to species discovery, such as combining biodiversity surveys with large-scale DNA sequencing. This would in turn allow ecologists, who often collect plants in poorly known regions, to make a greater contribution to the species-discovery process.

RESUMEN. *Inga pitmanii* K. G. Dexter & T. D. Penn. es descrita como una nueva especie del género *Inga* Mill. de Madre de Dios, Perú. Morfológicamente es más similar a *I. chartacea* Poepp. & Endl., con alas anchas en el rachis, inflorescencia espigada, hojas glabras, nueve a 10 nervios secundarios e indumento parecido en el cáliz. *Inga pitmanii* se diferencia de *I. chartacea* por el número de folíolos (cuatro pares vs. dos hasta tres), los nectarios foliares (ciatiformes vs. pateliformes), y las flores más grandes (corola 9–11.5 mm vs. 4.5–7 mm). La especie fue descubierta durante los censos hechos para un estudio ecológico del género *Inga*. Análisis filogenéticos muestran que esta especie forma parte de un grupo que incluye a *I. acreana* Harms e *I. chartacea*. Esta especia fue descubierta en censos de campo para un estudio ecológico del género en la Estación Biológica Los Amigos, en Madre de Dios, Perú. Estos censos descubrieron algunas especies de *Inga* potencialmente nuevas, que no coinciden en sus características vegetativas con ninguna de las especies de *Inga* conocidas hasta ahora. Además, la mayoría de estas especies demostraron ser distintas genéticamente. Aquí se describe únicamente *I. pitmanii*, porque es la única especie que se ha encontrado en estado fértil. Debido a las limitaciones que tanto la competencia como el financiamiento imponen a la taxonomía hoy en día, y éstas aunadas a la convención de describir especies nuevas solo y únicamente sí son fértiles, sugerimos que deberían considerarse métodos alternativos para descubrir nuevas especies, tales como la combinación de censos de biodiversidad y las secuencias de ADN en una escala mayor. Esto, a su vez permitirá a los ecólogos que frecuentemente recolectan plantas en regiones poco conocidas, contribuir al descubrimiento de nuevas especies.

Key words: Fabaceae, *Inga*, IUCN Red List, lowland Amazon, Madre de Dios, Peru.

Inga Mill. (Fabaceae: Mimosoideae) is a characteristic tree genus of Neotropical rainforests with a distribution extending from northwestern Mexico to Uruguay. The genus currently comprises more than 250 named species (Pennington, 1997). Despite being ecologically important, abundant, and frequently collected, it is estimated that there may be 50 or more imperfectly known or undescribed species in the genus (Pennington, 1997).

The Madre de Dios Department, in southeastern Peru, consists almost entirely of lowland, Amazonian rainforest. While there is limited human impact associated with several towns, roads, and extractive activities (gold mining, logging), the rainforests of the

department are in largely pristine condition. The two principal habitat types in the department are upland terra firme forest and bottomland floodplain forest (Terborgh, 1990; Pitman et al., 1999). Minor habitat types include permanently inundated areas such as *Mauritia flexuosa* L. f. palm swamps (aguajales) and *Ficus trigona* L. f.-dominated swamps (renacales). Also, much of the forest in terra firme is dominated by woody bamboo species, principally *Guadua* Kunth.

We undertook an ecological study of the distribution and dispersal of *Inga* across environmental gradients in Madre de Dios (Dexter, 2008; Dexter et al., 2010). As part of this study, we made extensive collections of *Inga* individuals, which were generally sterile, in order to identify and delimit species (Dexter et al., 2010). After comparison with the extensive collections of *Inga* at Kew and several U.S. herbaria (DUKE, MO, NY, US), an estimated 10 of our morphospecies were unassignable to known species. One of these morphospecies was collected in a fertile state and is described herein.

Inga pitmanii K. G. Dexter & T. D. Penn., sp. nov. TYPE: Peru. Madre de Dios: Los Amigos Biol. Station, Rio Los Amigos, 12°34′S, 70°05′W, 8 June 2004 (fl.), *K. Dexter & F. Parra 336* (holotype, K; isotype, DUKE). Figure 1.

Haec species *Ingae chartaceae* Poepp. affinis, sed ab ea foliolis 4-jugis, nectariis foliaribus brevistipitatis cyathiformibus, foliolorum nervibus secundariis paucioribus utrinque elevatis, pedunculo longiore et floribus majoribus differt.

Tree 25–35 cm DBH with tan-gray, lenticellate, smooth bark, slash orange, exuding a clear yellow exudate; young shoots angular, pale lenticellate, grayish brown, initially sparsely and minutely appressed puberulent, becoming glabrate. Stipules 1–1.5 × 0.1–0.15 cm, linear to falcate, subglabrous, caducous; petiole 4.5–5.5 cm, winged portion 4–6 mm wide, glabrous; rhachis 14.6–18.5 cm, winged portion 0.6–1.1 cm wide, glabrous, appendix ca. 1.2 cm, or absent; foliar nectaries shortly stalked (≤ 1 mm), cyathiform, ca. 2 mm diam.; petiolule 3–4 mm, glabrous; leaflets in 4 pairs, the terminal pair 19–25.5 × 7.6–9 cm, elliptic to oblong-elliptic, apex short to long acuminate, base rounded and finally slightly cordate, slightly asymmetrical; basal pair 10–11.2 × 4.5–5.1 cm, elliptic, apex acuminate, base truncate to slightly cordate; glabrous; venation eucamptodromous, secondary veins in 9 or 10 pairs, ascending, arcuate and convergent, raised on both surfaces when dry, intersecondary veins present, extending about halfway to the margin, tertiary veins mostly oblique and parallel. Inflorescence axillary, solitary, a strongly congested spike; peduncle ca. 6 cm, slender, glabrous; fertile rhachis 2–3 mm; bracts 2–3 mm, spatulate, sparsely puberulent, persistent; pedicel 0.5–1 mm, puberulent. Flowers with a whitish appearance to the corolla and stamens; calyx tube 6–7 mm, slightly expanded from base to apex; lobes 0.5–1 mm, triangular, acute at apex, calyx sparsely puberulent, more densely puberulent on the lobes; corolla tube 8–10 mm, lobes 1–1.5 mm, triangular, acute at apex, densely and coarsely pubescent outside; stamens ca. 50, staminal tube 1.1–1.4 cm, 0.5–0.75 mm diam., finally exserted 1–2 mm, free filaments 1–1.2 cm; ovary of 1 carpel, glabrous, style equaling the stamens, style head capitate; ovules ca. 16. Legume unknown.

Distribution and ecology. At present the species is known with certainty only from the type collection in Madre de Dios, Peru, which was the only fertile collection seen by the authors. There *Inga pitmanii* occurs in primary forest on nonflooded terraces with sandy soil. Additional sterile collections are from both nonflooded terraces with sandy soil and seasonally flooded terraces with clayey soil and are cited as paratypes.

IUCN Red List category. As of now, we recommend that this species be classified as Least Concern (LC), according to IUCN Red List criteria (IUCN, 2001). Although the species is locally rare, it appears to be present across Madre de Dios, and the rainforest habitat of the species is fairly intact. If the forests of Madre de Dios face extensive clearance in the future, the status of the species should be reevaluated, because it is not currently known from any other locations.

Phenology. Flowering occurs at the beginning of the dry season in June.

Etymology. This species is named in honor of Nigel Pitman for his dedicated efforts to advance Peruvian research capacity while research director of the Los Amigos Biological Station, where the type specimen was collected. Furthermore, the type specimen was collected when Nigel Pitman was teaching the first author of this article how to climb and collect tree materials. The type specimen was in fact the first *Inga* ever collected by the first author, whose dissertation research focused largely on *Inga*.

Discussion. *Inga pitmanii* is assigned to section *Pseudinga* Benth. on the basis of its short stalked foliar nectary, congested spike inflorescence, and calyx and corolla length. The diagnostic characters of the species are the large glabrous leaves with winged rachi, long petioles, congested inflorescences on long

Figure 1. *Inga pitmanii* K. G. Dexter & T. D. Penn. —A. Fertile habit. —B. Leaf, abaxial surface. —C. Leaf axil and stipule. —D. Foliar nectary, adaxial view. —E. Foliar nectary, lateral view. —F. Inflorescence. —G. Individual flower. Drawn from the holotype *Dexter & Parra 336* (K).

peduncles, and small, densely pubescent corollas. These characters indicate that the new taxon is most closely related to *I. chartacea* Poepp. & Endl., also in section *Pseudinga*, and it keys out at that species in a recent monograph of *Inga* (Pennington, 1997). However, there are several significant differences in both vegetative and floral morphology between the new species and *I. chartacea*. Leaflets are in four pairs in *I. pitmanii* (vs. two or three pairs in *I. chartacea*); foliar nectaries are shortly stalked and cyathiform (vs. sessile and patelliform); and the secondary veins are in nine to 10 pairs, raised on both surfaces (vs. 11 to 13 pairs and usually impressed adaxially). Furthermore, the fertile peduncles are longer in *I. pitmanii* (ca. 6 cm vs. 0.8–3 cm in *I. chartacea*); the flowers are larger, with the calyx tube 6–7 mm long (vs. 1.75–2.5 mm); the corolla tube is 8–10 mm long (vs. 3.5–5.5 mm); the staminal tube is 1.1–1.4 cm long (vs. 5.5–6.5 mm); and the free filaments are 1–1.2 cm long (vs. 6–7 mm).

As part of a previous study, we conducted exhaustive maximum likelihood and Bayesian phylogenetic analyses of *Inga* species in Madre de Dios, Peru, based on sequences of the nuclear ITS and chloroplast *trnD-T* markers (Dexter et al., 2010). This placed the new species (labeled in Dexter et al.,

2010, as *Inga* morphospecies 49) as sister to a clade that includes *I. acreana* Harms and *I. chartacea* with moderately strong posterior probability support. The phylogenetic analyses suggest that all sequenced specimens of *I. pitmanii* form a monophyletic clade, although there is not strong support for this hypothesis. Further sequencing efforts are needed to definitively confirm that the species forms a monophyletic clade and that its closest relatives are *I. acreana* and *I. chartacea*. We note that this phylogenetic analysis only included species from Madre de Dios; thus, it is possible that an unsampled species outside of this study area may actually be more closely related to *I. pitmanii*.

Inga pitmanii is one of 10 morphospecies of *Inga* that we uncovered in our ecological surveys in Madre de Dios and to which we were not able to assign a taxonomic name (Dexter et al., 2010). The other morphospecies are only represented by sterile collections. Convention dictates that they remain unnamed until fertile collections are found. However, each of these species is vegetatively distinct from all other *Inga* species known to date from the Amazon basin, and in most cases, also genetically distinct from all co-occurring species (Dexter et al., 2010). This suggests the species are likely new to science.

Ecologists, particularly tropical ecologists, frequently encounter sterile plants (or other organisms) to which they are not able to definitively assign a species name. While many of these individuals may belong to previously described species, many of them may also represent novel species. The status of these individuals as novel species can be assessed by comparing their DNA sequences to a large database of sequences from closely related, taxonomically identified individuals (e.g., through a DNA barcoding approach). Unique status would be indicated if their DNA sequences are distinct from those of close relatives. Given that taxonomic expertise and funding are on the decline, we advocate considering such alternative approaches to describing species. A combination of ecological or other biodiversity surveys with large-scale DNA sequencing, as presented here (Dexter et al., 2010), offers the possibility of greatly increasing the rate of documentation of novel species (Janzen et al., 2005; Caesar et al., 2006). This could be particularly critical in tropical ecosystems, which face grave threats and where most undiscovered diversity lies (e.g., Hebert et al., 2004; Janzen et al., 2005).

Additional specimens examined. PERU. **Madre de Dios:** Centro de Monitoreo Los Amigos, 5 May 2006 (sterile), *K. G. Dexter & C. Lazo 1171* (DUKE); Cocha Cashu Biological Station, 1 July 2006 (sterile), *K. G. Dexter & C. Lazo 2992* (DUKE); Las Piedras Biodiversity Station, 3–5 Nov. 2006 (sterile), *K. G. Dexter, E. Quispe & J. C. Lara 3956* (DUKE), *3986* (DUKE), *3988* (DUKE), *4017* (K), *4071* (DUKE).

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New Combinations Within the *Briza* Complex (Poaceae, Pooideae, Poeae)

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Abstract. *Briza* L. (Poaceae, Pooideae, Poeae) is a genus with a controversial circumscription, being either considered sensu lato, including Eurasian and South American species (e.g., Longhi-Wagner, 1987), or sensu stricto, including only four Eurasian species and being considered closely related to the South American species, forming the *Briza* complex (Matthei, 1975). According to recent phylogenetic analysis, *Briza* should be accepted sensu stricto, with four Eurasian species, as proposed by Matthei (1975) and other authors. The American species, which were previously published under *Briza* s.l. or under the genera *Calotheca* Desv., *Chascolytrum* Desv., *Erianthecium* Parodi, *Gymnachne* Parodi, *Lombardochloa* Roseng. & B. R. Arrill., *Microbriza* Parodi ex Nicora & Rúgolo, *Poidium* Nees, and *Rhombolytrum* Link, should be included within *Chascolytrum*, the oldest generic name published for the American species of the complex. As a result, the following 13 new combinations are proposed in *Chascolytrum*: *C. ambiguum* (Hack.) Essi, Longhi-Wagner & Souza-Chies, *C. bidentatum* (Roseng., B. R. Arrill. & Izag.) Essi, Longhi-Wagner & Souza-Chies, *C. brachychaetum* (Ekman) Essi, Longhi-Wagner & Souza-Chies, *C. brasiliense* (Nees ex Steud.) Essi, Longhi-Wagner & Souza-Chies, *C. brizoides* (Lam.) Essi, Longhi-Wagner & Souza-Chies, *C. bulbosum* (Parodi) Essi, Longhi-Wagner & Souza-Chies, *C. calotheca* (Trin.) Essi, Longhi-Wagner & Souza-Chies, *C. itatiaiae* (Ekman) Essi, Longhi-Wagner & Souza-Chies, *C. koelerioides* (Trin.) Essi, Longhi-Wagner & Souza-Chies, *C. monandrum* (Hack.) Essi, Longhi-Wagner & Souza-Chies, *C. poomorphum* (J. Presl) Essi, Longhi-Wagner & Souza-Chies, *C. rhomboideum* (Link) Essi, Longhi-Wagner & Souza-Chies, and *C. uniolae* (Nees) Essi, Longhi-Wagner & Souza-Chies. The names *Poa koelerioides* Trin., *Poa tumidula* Steud., *Poidium brasiliense* Nees ex Steud., and *Rhombolytrum berteroanum* E. Desv. are lectotypified.

Key words: *Briza* complex, *Chascolytrum*, Eurasia, Gramineae, South America.

The genus *Briza* L. (Linnaeus, 1753; Poaceae, Pooideae, Poeae) was published with three European species, *B. maxima* L., *B. minor* L., and *B. media* L. Another Old World species, *B. humilis* M. Bieb., was added later, in 1808. Several new South American species were afterward described under *Briza* or under the genera *Chascolytrum* Desv., *Calotheca* Desv., *Poidium* Nees, *Lombardochloa* Roseng. & B. R. Arrill., and *Microbriza* Parodi ex Nicora & Rúgolo (Nicora & Rúgolo de Agrasar, 1981). Further taxonomic treatments (e.g., Ekman, 1913; Parodi, 1920; Rosengurtt et al., 1968, 1970; Longhi-Wagner, 1987) accepted a broad circumscription for *Briza*, some including sections or subgenera for *Briza* to accommodate such great morphological variability.

Matthei (1975) published a revision of *Briza* and related genera, jointly referred as the *Briza* complex, using morphological, anatomical, and cytological data. This author accepted *Briza* s. str., restricted to the Eurasian species, and distributed the American species among the genera *Calotheca*, *Chascolytrum*, and *Poidium*, a move that was followed by other authors (Smith et al., 1981; Soreng et al., 2003).

Nicora and Rúgolo de Agrasar (1981) described the genus *Microbriza* for two species previously accepted under *Briza* or *Poidium*: *M. brachychaete* (Ekman) Parodi ex Nicora & Rúgolo and *M. poomorpha* (J. Presl) Parodi ex Nicora & Rúgolo [as "*poaemorpha*"]. Additionally, Nicora and Rúgolo de Agrasar (1981) accepted *Briza* with a different circumscription from that proposed by Matthei (1975), including not only the Eurasian species, as in Matthei (1975), but also the American species previously described under the genus *Chascolytrum*

and a portion of the species described in *Poidium*. Nicora and Rúgolo de Agrasar (1981) accepted the genera *Calotheca*, *Poidium*, and *Rhombolytrum* Link for the remaining species of this complex.

Bayón (1998) published a cladistic analysis of the *Briza* complex based on 32 morphological characters, resulting in the acceptance of the genera proposed by Nicora and Rúgolo de Agrasar (1981), with similar circumscription. Recently, Essi et al. (2008) performed a phylogenetic analysis of the *Briza* complex based on molecular data that included three other related genera, *Erianthecium* Parodi, *Rhombolytrum*, and *Gymnachne* Parodi. This study resulted in the acceptance of *Briza* s. str. with four Eurasian species, and in the proposal of a new circumscription for the genus *Chascolytrum*, including all the accepted South American species previously assigned to the other genera cited above. The necessary new combinations resulting from this new circumscription are proposed in the present work.

Materials and Methods

This work was based on field collections, traditional revision of herbaria, and review of literature. Field collections covered the southernmost Brazilian states. The following herbaria were consulted: B, BLA, BM, Centro Nacional de Pesquisa em Ovinos, CONC, CORD, FLOR, G, GUA, HAS, HB, HBR, ICN, K, L, LINN, LPB, M, MBM, MO, MSB, NY, P, PACA, RB, S, SGO, SMDB, UEC, VIC, and W. Electronic images provided by BAA, GOET, PR, and US were also examined.

New Combinations

Chascolytrum Desv., Nouv. Bull. Sci. Soc. Philom. Paris 2: 190. 1810. *Briza* sect. *Chascolytrum* (Desv.) Benth. & Hook., Gen. Pl. 3(2): 1195. 1883. *Briza* subg. *Chascolytrum* (Desv.) Parodi, Revista Fac. Agron. Veterin. (Buenos Aires) 3: 120. 1920. TYPE: *Chascolytrum subaristatum* (Lam.) Desv.

Calotheca Desv., Nouv. Bull. Sci. Soc. Philom. Paris 2: 190. 1810, nom. orth. cons., non *Calosteca* Desv. *Briza* sect. *Calotheca* (Desv.) Benth. & Hook., Gen. Pl. 3(2): 1195. 1883. *Briza* subg. *Calotheca* (Desv.) Parodi, Revista Fac. Agron. Veterin. (Buenos Aires) 3: 130. 1920, syn. nov. TYPE: *Calotheca brizoides* (Lam.) Desv.

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Lombardochloa Roseng. & B. R. Arrill., Anales Fac. Quimica Montevideo 9: 260. 1979. *Briza* sect. *Lombardochloa* (Roseng. & B. R. Arrill.) Longhi-Wagner, Bol. Inst. Bioci. Univ. Fed. Rio Grande do Sul 41: 22. 1987, syn. nov. TYPE: *Lombardochloa rufa* (J. Presl) Roseng. & B. R. Arrill.

Microbriza Parodi ex Nicora & Rúgolo, Darwiniana 23(1): 292. 1981, syn. nov. TYPE: *Microbriza poimorpha* (J. Presl) Parodi ex Nicora & Rúgolo.

1. **Chascolytrum ambiguum** (Hack.) Essi, Longhi-Wagner & Souza-Chies, comb. nov. Basionym: *Briza ambigua* Hack., Oesterr. Bot. Z. 52(8): 308. 1902. *Poidium ambiguum* (Hack.) Matthei, Willdenowia 8: 121. 1975. TYPE: Brazil. "Brasilia, in provincia Rio de Janeiro," 1889, *A. F. M. Glaziou 17956* (holotype, W-17140; isotypes, BAA-361 [B fragm.] not seen, CP not seen, G, K, LE not seen, MO, US-865537 [W fragm., image seen]).

2. **Chascolytrum bidentatum** (Roseng., B. R. Arrill. & Izag.) Essi, Longhi-Wagner & Souza-Chies, comb. nov. Basionym: *Briza bidentata* Roseng., B. R. Arrill. & Izag., Bol. Fac. Agron. Univ. Montevideo 105: 24. 1968. Replaced name: *Eragrostis monandra* Hack., Repert. Spec. Nov. Regni Veg. 7: 320. 1909. Blocking name: *Briza monandra* (Hack.) Pilg., Notizbl. Bot. Gart. Berlin-Dahlem 10(97): 725. 1929. *Rhombolytrum monandrum* (Hack.) Nicora & Rúgolo, Darwiniana 23: 302. 1981. TYPE: Brazil. Rio Grande do Sul: "Rio Pardo, prope Fazenda Soledade," 70 m, Dec. 1905, *C. Jürgens s.n.* (holotype, W; isotypes, BAA not seen, US-90610 not seen).

3. **Chascolytrum brachychaetum** (Ekman) Essi, Longhi-Wagner & Souza-Chies, comb. nov. Basionym: *Briza brachychaete* Ekman, Ark. Bot. 13(10): 60. 1913. *Poidium brachychaetum* (Ekman) Matthei, Willdenowia 8: 107. 1975. *Microbriza brachychaete* (Ekman) Parodi ex Nicora & Rúgolo, Darwiniana 23(1): 296. 1981. TYPE: Brazil. [Paraná:] "altoplanitie, Curytiba, in campo," 15 Feb. 1911, *P. K. Dusén 13390* (holotype, S; isotypes, BAA-367

[B fragm.] not seen, BM, K, L, US-601229 [S fragm., image seen], US-865538 [S fragm., image seen], W-39083 not seen).

4. Chascolytrum brasiliense (Nees ex Steud.) Essi, Longhi-Wagner & Souza-Chies, comb. nov. Basionym: *Poidium brasiliense* Nees ex Steud., Syn. Pl. Glumac. 1(3): 288. 1854. *Briza brasiliensis* (Nees ex Steud.) Ekman, Ark. Bot. 13(10): 57. 1913. *Poa poidium* Döll, Fl. Bras. 2(3): 119. 1878. TYPE: Brazil. "civit. Paraná, in parte septentrionali civitatis," s.d., *F. Sellow 4848* (lectotype, designated here, BAA [image seen]; duplicate, US-98434 [image seen]).

Notes. According to Matthei (1975), the holotype of *Poidium brasiliense* Nees ex Steud. (*Sellow 4848* at B herbarium) was destroyed; therefore, he proposed a neotype, *Glaziou 6774* (P). However, this specimen belongs to *Briza itatiaiae* Ekman, which Matthei (1975) placed in synonymy. In the present study *B. itatiaiae* is accepted as *Chascolytrum itatiaiae* (Ekman) Essi, Longhi-Wagner & Souza-Chies. Nicora and Rúgolo de Agrasar (1981) had already noticed this problem and indicated there was a fragment of the holotype of *P. brasiliense* Nees ex Steud. at the herbarium BAA. This material was analyzed and confirmed as belonging to the original type collection of *P. brasiliense* Nees ex Steud. Another fragment of *Sellow 4848* was found at US. The neotype proposed by Matthei (1975: 112) cannot be accepted, and furthermore it belongs to *B. itatiaiae* according to the circumscription accepted here. The specimen *Sellow 4848* (BAA) is now proposed as a lectotype. The fragment from BAA was chosen for lectotypification because it is the material discussed in detail (including leaf anatomy) by Nicora and Rúgolo de Agrasar (1981).

5. Chascolytrum brizoides (Lam.) Essi, Longhi-Wagner & Souza-Chies, comb. nov. Basionym: *Bromus brizoides* Lam., Tabl. Encycl. 1: 193. 1791. *Calotheca brizoides* (Lam.) Desv., Nouv. Bull. Sci. Soc. Philom. Paris 2: 190. 1810. *Briza brizoides* (Lam.) Kuntze, Revis. Gen. Pl. 3(3): 341. 1898. TYPE: Uruguay. "E. Monte-Video," *P. Commerson s.n.* (holotype, P).

Briza patula Phil., Anales Univ. Chile 94: 163. 1896. TYPE: Chile. supra Angol, Nov. 1887 (holotype, SGO-62648 not seen).

Briza tandilensis Parodi, Revista Fac. Agron. Veterin. (Buenos Aires) 3: 132. 1920. TYPE: Argentina. Buenos Aires: cerros del Tandil, Nov. 1919, *L. R. Parodi s.n.* (holotype, BAA [image seen]; isotype, US-1108548 [BAA fragm.]).

6. Chascolytrum bulbosum (Parodi) Essi, Longhi-Wagner & Souza-Chies, comb. nov. Basionym: *Erianthecium bulbosum* Parodi, Notas Mus. La Plata, Bot. 8: 77, fig. 1. 1943. TYPE: Uruguay. Minas: cerro Arequita, frecuente en pedregal arbustivo y pratense, 15 Oct. 1939, *B. Rosengurtt 3154* (holotype, BAA [image seen]).

7. Chascolytrum calotheca (Trin.) Essi, Longhi-Wagner & Souza-Chies, comb. nov. Basionym: *Eragrostis calotheca* Trin., Mem. Acad. Imp. Sci. St. Pétersbourg, Sér. 6, Sci. Math. 1(4): 414. 1830. *Poa calotheca* (Trin.) Kunth, Enum. Pl. 1: 340. 1833. *Briza calotheca* (Trin.) Hack., Bull. Herb. Boissier, sér. 2, 4(3): 282. 1904. *Poidium calotheca* (Trin.) Matthei, Willdenowia 8: 116. 1975. TYPE: [Brazil. São Paulo:] "V. spp. Bras. Sto. Paulo, in fruticeis humidis prope Jundiahy," Oct. 1825, *Riedel s.n.* (holotype, LE-TRIN-2315 not seen; isotypes, LE not seen, US-2891459 [image seen]).

Briza poa Nees ex Steud., Syn. Pl. Glumac. 1: 283. 1854. TYPE: Brasilia, *F. Sellow s.n.* (lectotype, designated by Matthei [1975: 116], CGE not seen; duplicates, BAA-391 [B fragm.] not seen, LE-TRIN-2552 not seen).

Briza neesii Döll, Fl. Bras. 2(3): 132. 1878. nom. illeg. superfl.

Briza neesii Döll var. *flaccida* Döll, Fl. Bras. 2(3): 133. 1878. TYPE: Brazil. *Anonymous s.n.* [Academiae Petropolitanae specimina] (holotype, LE not seen).

8. Chascolytrum itatiaiae (Ekman) Essi, Longhi-Wagner & Souza-Chies, comb. nov. Basionym: *Briza itatiaiae* Ekman, Ark. Bot. 13(10): 58, t. 4, fig. 1. 1913. *Poidium itatiaiae* (Ekman) Nicora & Rúgolo, Darwiniana 23(2): 306. 1981. TYPE: Brazil. [Minas Gerais:] "Serra do Itatiaia, in monticulo Serra da Pedra Assentada," 2400 m, 19 May 1902, *P. K. Dusén 292* (lectotype, designated by Matthei [1975: 112], S; duplicates, R not seen, US not seen).

9. Chascolytrum koelerioides (Trin.) Essi, Longhi-Wagner & Souza-Chies, comb. nov. Basionym: *Poa koelerioides* Trin., Mem. Acad. Imp. Sci. St-Pétersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 4, 2(1): 62. 1836. *Gymnachne koelerioides* (Trin.) Parodi, Revista Argent. Agron. 29(1–2): 19. 1962 [1963]. TYPE: Chile. Quillota: "in pascuis sylvaticis collium editiorum," Oct. 1829, *C. G. Bertero 947* (lectotype, designated here, P; duplicates, LE not seen, US-88773 [P fragm., image seen]).

Poa tenuiculmis Steud., Syn. Pl. Glumac. 1: 259. 1854, nom. illeg. superfl.

Rhombolytrum berteroanum E. Desv., Fl. Chil. 6: 387. 1854. TYPE: Chile: Los Llanos, provincia de Valdivia, [*C.*] *Gay* [*Mouret*] *298* (lectotype, designated here, P; duplicates, K, US-90608 [image seen]).

Gymnachne jaffuelii Parodi, Notas Mus. La Plata, Bot. 3(17): 30. 1938. TYPE: Chile. Concepción: *F. Jaffuel 1884* (holotype, BAA not seen).

Notes. Two syntypes were cited in the protologue of *Poa koelerioides* Trin., one collected by C. G. Bertero (*C. G. Bertero 947*) and another attributed to Prescott (*Prescott 1832*). The latter specimen is considered by Soreng et al. (2003) as being from the same collection *C. G. Bertero 947*. The collection *C. G. Bertero 947* is also included in the protologue of *Rhombolytrum berteroanum* E. Desv. as one of the two syntypes (the other specimen is the collection *Gay 298*, P, duplicates K, US-90608 [image seen]). The specimen seen at P (*Bertero 947*) is well conserved and matches with the original description of *P. koelerioides* Trin. It also matches with its synonym *R. berteroanum* E. Desv., but for this last species the collection *Gay 298* was preferred in order to avoid using the same lectotype for two different names.

10. Chascolytrum monandrum (Hack.) Essi, Longhi-Wagner & Souza-Chies, comb. nov. Basionym: *Poa monandra* Hack., Oesterr. Bot. Z. 52(10): 376–377. 1902. *Briza monandra* (Hack.) Pilg., Notizbl. Bot. Gart. Berlin-Dahlem 10(97): 725. 1929. *Poidium monandrum* (Hack.) Matthei, Willdenowia 8: 103. 1975. TYPE: prope Cutervo, May 1879, *C. von Jelski 402* (holotype, W-41656; isotypes, US-88757 [W fragm., image seen], W-14194).

Calotheca stricta Hook. & Arn. var. *mandoniana* Griseb., Abh. Königl. Ges. Wiss. Göttingen 24: 289. 1879. *Briza mandoniana* (Griseb.) Henrard, Meded. Rijks-Herb. 40: 70. 1921. TYPE: Bolivia. *G. Mandon* [*1356*] (holotype, GOET; isotypes, G, GH not seen, L not seen, LE not seen, P, S not seen, W).

Briza lilloi Parodi, Revista Fac. Agron. Veterin. (Buenos Aires) 3: 133, f. 7(1). 1920. TYPE: Argentina. Tucuruan, La Cienaga, 1905, *M. Lillo 4094* (holotype, BAA not seen).

Briza mandoniana (Griseb.) Henrard var. *herzogiana* Henrard, Meded. Rijks-Herb. 40: 71. 1921. TYPE: "Auf Alpenwiesen bei Choquetanga grande," Oct. 1911, *T. Herzog 3017* (holotype, L; isotype, L).

Briza mandoniana (Griseb.) Henrard var. *tuberculata* Henrard, Meded. Rijks-Herb. 40: 71. 1921. TYPE: "In vicinis Sorata, cerro del Iminapi in humo pingui," Jan. Mar. 1860, *G. Mandon 1355* (holotype, L; isotypes, BM, G, K, NY, P, S, US-865545 not seen, W).

Briza mandoniana (Griseb.) Henrard var. *vallegrandensis* Henrard, Meded. Rijks-Herb. 40: 71. 1921. TYPE: "In subalpinen Gebüsch des Berges über Vallegrande," Mar. 1911, *T. Herzog 1879* (holotype, L; isotypes, L, S, US-865546 not seen).

11. Chascolytrum poomorphum (J. Presl) Essi, Longhi-Wagner & Souza-Chies, comb. nov. Basionym: *Panicum poomorphum* J. Presl, in C. Presl, Reliq. Haenk. 1(4–5): 310. 1830, as "*poaemorphum*." *Briza poomorpha* (J. Presl) Henrard, Meded. Rijks-Herb. 40: 73. 1921, as "*poaemorpha*." *Poidium poomorphum* (J. Presl) Matthei, Willdenowia 8: 108. 1975, as "*poaemorphum*." *Microbriza poomorpha* (J. Presl) Parodi ex Nicora & Rúgolo, Darwiniana 23(1): 295. 1981, as "*poaemorpha*." TYPE: Peru. "Hab. in montanis Peruviae huanoccensibus," s.d., *T. Haenke s.n.* (holotype, PR [image seen]; isotypes, B not seen, BAA not seen, US-975970 not seen).

Isachne hackelii Lindm., Kongl. Svenska Vetenskapsakad. Handl., n.s. 34(6): 11, t. 5. 1900. *Briza hackelii* (Lindm.) Ekman, Ark. Bot. 13(10): 61. 1913. TYPE: Bras. Civ. Rio Grande do Sul: Porto Alegre, Parthenon, *C. A. M. Lindman* [*Exp. I. Regn.*] *A595* (holotype, W not seen; isotype, US-702321 not seen).

Briza hackelii f. *pseudisachne* Ekman, Ark. Bot. 13(10): 61. 1913. TYPE: Bras. Civ. Rio Grande do Sul: Rio Grande do Sul oppidum in campo arenoso loco subumido, 7 Nov. 1901, *G. Malme* [*Exp. Regn.*] *250* (holotype, S).

12. Chascolytrum rhomboideum (Link) Essi, Longhi-Wagner & Souza-Chies, comb. nov. Basionym: *Rhombolytrum rhomboideum* Link, Hort. Berol. 2: 296. 1833, as "*Rhomboelytrum*." TYPE: Chile. "Habitat in Chile, e seminibus ideallitis enata," *Anonymous s.n.* (holotype, B not seen; isotypes, BAA-2759 [B fragm.] not seen, P, US-946981b not seen).

Poa tumidula Steud., Syn. Pl. Glumac. 1: 258. 1854. TYPE: Chile. Cachapuel Rancagua, *Bertero 277* (lectotype, designated here, P; duplicate, US-90609 [image seen]).

Rhombolytrum quinquenervium Phil., Linnaea 33(3 4): 293. 1864. TYPE: "Prope 'los Molles' in prov. Aconcagua," *R. A. Philippi s.n.* (holotype, SGO not seen; isotypes, P not seen, US not seen).

13. Chascolytrum uniolae (Nees) Essi, Longhi-Wagner & Souza-Chies, comb. nov. Basionym: *Eragrostis uniolae* Nees, Fl. Bras. Enum. Pl. 2(1): 494. 1829. *Briza uniolae* (Nees) Nees ex Steud., Syn. Pl. Glumac. 1: 283. 1854. *Poidium uniolae* (Nees) Matthei, Willdenowia 8: 93. 1975. TYPE: [Brazil or Paraguay.] "Habitat in confinibus regni Paraguayani," *F. Sellow s.n.* (holotype, B not seen; isotypes, BAA-405 [B. fragm., image seen], LE-TRIN-2405.01 not seen).

Chascolytrum spicigerum J. Presl, Reliq. Haenk. 1(4–5): 282. 1830. *Briza spicigera* (J. Presl) Steud., Nomencl.

Bot. (ed. 2) 1: 225. 1840. TYPE: "Hab. in Peruviae montanis et in Chile," *T. Haenke s.n.* (holotype, PR not seen; isotypes, M not seen, MO, US [fragm.] not seen, W).

Briza uniolae (Nees) Nees ex Steud. var. *modestior* Döll, Fl. Bras. 2(3): 131. 1878. TYPE: "In insula S. Catharinae," *F. Müller s.n.* (holotype, B; isotype, US [fragm.] not seen).

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Nomenclatural Changes for *Zornia* (Leguminosae, Papilionoideae, Dalbergieae) in Brazil

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Abstract. While studying the species of *Zornia* J. F. Gmel. (Leguminosae, Papilionoideae, Dalbergieae) from Brazil for taxonomic revision of the genus, eight lectotypifications are proposed: *Hedysarum bifolium* Vell., *Z. diphylla* (L.) Pers. var. *bernardinensis* Chodat & Hassl., *Z. diphylla* var. *elatior* Benth., *Z. diphylla* f. *ciliata* Chodat & Hassl., *Z. myriadena* Benth., *Z. perforata* Vogel, *Z. reticulata* Sm., and *Z. sericea* Moric., as well as two neotypifications for *Z. brasiliensis* Vogel and *Z. ovata* Vogel. A new combination, *Z. vichadana* (Killip ex Mohlenbr.) Fort.-Perez & A. M. G. Azevedo is proposed, based upon *Z. pardina* Mohlenbr. var. *vichadana* Kilip ex Mohlenbr. Eighteen new synonymizations are also included.

Key words: Brazil, Dalbergieae, Leguminosae, Neotropics, Papilionoideae, *Zornia*.

The genus *Zornia* J. F. Gmel. (Leguminosae, Papilionoideae) comprises approximately 75 to 80 species from the tropics and subtropics (Mohlenbrock, 1961; Rudd, 1981; Klitgaard & Lavin, 2005). According to a recent molecular study carried out by Lavin et al. (2001), the genus is included in the informal *Adesmia* DC. clade of the tribe Dalbergieae s.l., based on DNA sequences from the chloroplast *trnK* (including *matK*) and *trnL* introns, and the nuclear ribosomal 5.8S and flanking internal transcribed spacers 1 and 2. The genus *Zornia* is morphologically characterized by a pair of peltate bracteoles similar to the stipules that surround each flower, the 2- or 4-foliolate leaves, and the stems that are normally branched and woody at the base.

The genus *Zornia* was established by Gmelin (1791) based on *Z. bracteata* J. F. Gmel. After studying this species that presents solitary flowers, Desvaux (1813) proposed a new genus, *Myriadenus* Desv., describing *M. tetraphyllus* (L.) Desv. De Candolle (1825), who published descriptions for both species in the two genera *Zornia* and *Myriadenus*, accepted this distinction. However, Vogel (1830) considered nine species of *Zornia* and, counter to Desvaux (1813), included in *Zornia* both species with solitary flowers and those with more. This treatment was later followed by Bentham (1859), Moricand (1844), and others. More than 30 species of *Zornia* were described when Bentham (1859) treated the genus for Martius's *Flora Brasiliensis*, where only eight species were accepted, divided between the two sections *Zornia* sect. *Myriadenus* (Desv.) Benth., and *Zornia* sect. *Zornia*. Bentham (1859) synonymized various species with *Z. diphylla* (L.) Pers. and established 14 infraspecific taxa within this species. The most recent monograph for the genus was done by Mohlenbrock (1961), who recognized two infragenera as *Zornia* subg. *Myriadena* (Desv.) Mohlenbr. and *Zornia* subg. *Zornia*, differentiated by their floral morphology, with the flowers solitary and pedicellate, or sessile to subsessile in inflorescences, and by the number of leaflets per leaf as four, or two or four, respectively.

During the revision of *Zornia* for Brazil by Fortuna-Perez (2009), more than 3000 accessions were analyzed through visits to European and Brazilian herbaria and loans from elsewhere, including AHUC, B, BHCB, BM, BR, CEN, CEPEC, CGMS, CTES, ESA, F, FHO, G, GH, H, HRCB, HST, HUEFS, IAC, IAN, IBGE, ICN, INPA, INTA, IPA, K, LIL, M, MBM, MEXU, MG, MICH, MO, MVM, NY, OXF, P, PACA, PAMG, PEUFR, RB, S, SI, SP, SPF, UB, UEC, US, W, Y, and Z. As part of this revision, 36 species were recognized, eight names have been found to be in need of lectotypification, and 18 names are proposed as new synonyms. Two neotypes are designated because the holotype was destroyed or lost and there are no known isotypes, and one new combination is proposed.

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LECTOTYPIFICATIONS, SYNONYMIZATIONS, AND NEOTYPIFICATIONS

Zornia J. F. Gmel., Syst. Nat., ed. 13 [bis] 2(2): 1076, 1096. 1791 [1792], non *Zornia* Moench, Methodus 410. 1794, nom. illeg. superfl. TYPE: *Zornia bracteata* J. F. Gmel.

Myriadenus Desv., J. Bot. Agric. 1: 121. 1813. TYPE: *Myriadenus tetraphyllus* (L.) Desv.

1. Zornia brasiliensis Vogel, Linnaea 12: 62–63. 1838, as "*Brasiliensis.*" TYPE: Brazil. Espírito Santo, Colatina, 28 Jan. 1997, *M. M. Arbo. et al. 7767* (neotype, designated here, NY).

Zornia brasiliensis Vogel var. *adenocarpa* L. P. Queiroz, Bol. Bot. Univ. São Paulo 16: 108 109. 1997, syn. nov. TYPE: Brazil. Minas Gerais: Grão-Mogol, 10 Dec. 1989, *P. T. Sano et al. 12384* (holotype, SPF; isotype, HUEFS, K).

Notes. When Vogel (1838: 63) described *Zornia brasiliensis*, he cited the collection *Sellow s.n.* (Brazil. "inter Campos et Victoria," s.d.), which was deposited at the Berlin Herbarium. Because none of Sellow's material has been found that corresponded to *Z. brasiliensis*, the type collection is presumed destroyed and a neotype is proposed for the name here. The locality of the original type collection corresponds to the Vale do Rio Doce region, located mainly in Espírito Santo state. The collection designated as neotype, *Arbo et al. 7767*, was collected in the Vale do Rio Doce region and is deposited at NY. The chosen specimen is characterized by the obovate leaflets that are cuneate at the base; the absence of auricles at the bracteoles; the asymmetrical bracteoles; the pubescent articles of the loment that lack reticulation, and the loment similar to those in *Desmodium*. These morphological aspects of the specimen confirm the neotype as representative of *Z. brasiliensis*.

Queiroz (1997) designated a new variety for *Zornia brasiliensis* (*Z. brasiliensis* var. *adenocarpa*), justifying this variety as different based on the loments with glands. However, our comprehensive study revealed that this characteristic occurred throughout the species, varying only in the number of the glands.

2. Zornia burkartii Vanni, Bonplandia (Corrientes) 5(20): 175. 1981. TYPE: Argentina. Corrientes: Ituzaingó, Playadito, 24 Sep. 1974, *A. Krapovickas et al. 26354* (holotype, CTES).

Zornia reticulata Sm. var. *glabra* Vogel, Linnaea 12: 58. 1838, syn. nov. TYPE: Brazil. 1841, *F. Sellow s.n.* (holotype, K).

Zornia reticulata Sm. var. *elongata* Vogel, Linnaea 12: 58. 1838, syn. nov. TYPE: Brazil. 1841, *F. Sellow s.n.* (holotype, K).

Notes. Mohlenbrock (1961) synonymized *Zornia reticulata* var. *glabra* Vogel and *Z. reticulata* var. *elongata* Vogel with *Z. reticulata* Sm., without further explanation. Our analysis of the type material clearly indicated that Vogel's two varieties correspond to variation accepted for the species *Z. burkartii*, since they have caducous leaves and an erect habit.

Bentham (1859) synonymized *Zornia reticulata* var. *glabra* to *Z. diphylla*, but *Z. diphylla* is characterized by loments with four articles, and by the articles 4.5–5 × 3.5–4 mm, without reticulation, glabrous, glandular, with numerous bristles 1.5–3.5 mm long. *Zornia burkartii* differs in having loments with four to seven articles, and by the articles 2–3 × 1.8–2 mm, reticulate, pubescent, eglandular, with bristles 0.5–1.5 mm long.

3. Zornia cryptantha Arechav., Anales Mus. Nac. Montevideo 3: 358. 1901. TYPE: Uruguay. Tacuarembó, s.d., *P. Pintos s.n.* (holotype, MVM 5362).

Zornia cryptantha Arechav. var. *latibracteata* Vanni, Bonplandia (Corrientes) 5: 180 181. 1981, syn. nov. TYPE: Argentina. Corrientes: Dep. Lavalle, 3 km de Yataity Calle, Rt. 120, 25 Nov. 1979, *A. Schinini, R. Vanni & G. Normann 19140* (holotype, CTES).

Notes. Vanni (1981) designated the variety *latibracteata* within *Zornia cryptantha*, justifying that it differed from the typical variety based on its wider bracteoles (7–11 mm wide vs. 7–10 mm wide in *Z. cryptantha*), oval bracteoles (vs. oval to oval-lanceolate in *Z. cryptantha*), and the upper leaflets (30–)39 mm long (vs. 22–42 mm long in *Z. cryptantha*). Our analysis of the type material clearly indicates that this variety corresponds to variation accepted for the species *Z. cryptantha*.

4. Zornia curvata Mohlenbr., Webbia 16(1): 132, figs. 62, 91. 1961. TYPE: Venezuela. Cotiza, near Caracas, 8 July 1917, *H. F. Pittier 7241* (holotype, US; isotype, GH not seen).

Zornia gavilanesii Brandão & Sousa Costa, Daphne 1(1): 5. 1990, syn. nov. TYPE: Brazil. Minas Gerais: Pouso Alegre, 5 Nov. 1984, *M. Brandão 10923* (holotype, RB; isotype, PAMG).

Zornia amaralaensis Brandão, Daphne 4(3): 5. 1994, syn. nov. TYPE: Brazil. Minas Gerais: Carneirinhos, 7 May 1975, *M. Brandão 906* (holotype, PAMG).

Notes. Our analysis of the type material for the two species *Zornia amaralaensis* and *Z. gavilanesii* published by Brandão (1994; Brandão & Sousa

Costa, 1990) verified that the observed morphological variations do not justify the separate recognition of these names at species rank, and therefore they are synonymized with *Z. curvata* here. Brandão and Sousa Costa (1990) differentiated *Z. gavilanesii* from *Z. curvata* by the stipule and bracteoles (cited as bracts by authors) that are bipartite and 6- to 8-nerved. According to Brandão (1994), *Z. amaralaensis* was previously included in *Zornia* subg. *Zornia* sect. *Isophylla* Mohlenbr. based on the upper and lower leaflets that are similar in shape; however, our analysis of the type material revealed a greater variability in leaflet shape.

5. Zornia echinocarpa (Moric. ex Meisn.) Benth., Fl. Bras. (Martius) 15(1): 85. 1859. Basionym: *Myriadenus echinocarpus* Moric. ex Meisn., Pl. Vasc. Gen. [Meisner] 3: 64(69–104, Tab. Diagn.). 1837. TYPE: Brazil. Bahia: s.d., *J. S. Blanchet 1682* (holotype, G).

Notes. In his revision of the genus, Mohlenbrock (1961) cited the material of *Blanchet 3842* (Jacobina, Bahia) as the type of *Zornia echinocarpa*; however, the type collection cited by Meisner (1837) does not include this material. The holotype collection mentioned by Meisner (1837) is *Blanchet 1682* and is deposited in the herbarium at G.

6. Zornia glabra Desv., Mém. Soc. Linn. Paris 4: 325. 1826. TYPE: Brazil. s.d., *P. A. M. Lavalleé s.n.* (holotype, P; isotype, F).

Zornia perforata Vogel, Linnaea 12: 59. 1838. *Zornia diphylla* var. *perforata* (Vogel) Kuntze, Revis. Gen. Pl. 3(3): 74. 1898. TYPE: Brazil. Bahia: s.d., *B. Luschnath s.n.* (lectotype, designated here, P).

Zornia diphylla (L.) Pers. var. *elatior* Benth., Fl. Bras. (Martius) 15(1): 81. 1859, non *Zornia diphylla* var. *elatior* Micheli, Bull. Herb. Boisser 6, App. 1: 33. 1898, nom. illeg. TYPE: Brazil. Bahia: Ilhéus, s.d., *B. Luschnath 401* (lectotype, designated here, BM; duplicates, G, K, NY, W)

Notes. Vogel (1838) cited two collections as the type of *Zornia perforata*, *Sellow s.n.* and *Luschnath s.n.* While visiting European herbaria, the first author found Luschnath's collection from Brazil in the Paris Herbarium. This material is complete and agrees with Vogel's original description; we therefore designate *Luschnath s.n.* as lectotype here.

Bentham (1859) considered *Zornia perforata* Vogel as a synonym of *Z. diphylla* var. *elatior.* In fact, both are morphologically identical with *Z. glabra*, and these taxa are treated as synonyms here. Bentham (1859) cited two collections of Luschnath (*401* and *1115*) as the type of *Z. diphylla* var. *elatior.* The first author analyzed both collections in different herbaria, and the material *Luschnath 401* that is deposited in K presents all characters described in the protologue and is designated as lectotype here.

7. Zornia latifolia Sm., Cycl. (Rees) 39: 206. 1819, non *Zornia latifolia* DC., Prodr. (DC.) 2: 317. 1825. TYPE: French Guiana. Cayenne, s.d., *J. B. C. F. Aublet s.n.* (holotype, P; isotype, BM).

Zornia gemella Willd. ex Vogel, Linnaea 12: 61. 1838, syn. nov. *Hedysarum gemellum* Willd. ex Vogel, nom. nud. TYPE: Brazil. s.d., "Habitat in Brasilia," *Sched. Willdenow Herb. 13778* (holotype, B-W).

Zornia gracilis DC., Prodr. (DC.) 2: 316. 1825, non *Zornia gracilis* Harms, Bot. Jahrb. Syst. 42(2–3): 212. 1908. *Zornia diphylla* var. *gracilis* (DC.) Benth., Fl. Bras. (Martius) 15(1): 83. 1859. TYPE: Guyana. 1821, *G. S. Perrottet 18* (holotype, G).

Zornia diphylla (L.) Pers. var. *bernardinensis* Chodat & Hassl., Bull. Herb. Boissier, ser. 2, 4: 888. 1904, syn. nov. *Zornia latifolia* Sm. var. *bernardinensis* (Chodat & Hassl.) Mohlenbr., Webbia 16(1): 128. 1961. TYPE: Paraguay. "Paraguay in campo San Bernardino," s.d., *E. Hassler 3502* (lectotype, designated here, G; duplicates, BM, W).

Zornia maranhamensis G. Don, Gen. Hist. 2: 280. 1832, syn. nov. TYPE: Brasil. Maranhão, s.d., *G. Don s.n.* (holotype, BR).

Zornia surinamensis Miq., Ann. Mag. Nat. Hist. 11: 14. 1843. TYPE: Suriname. "Surinam, locis elevatioribus," s.d., *s. coll.* (holotype, BR).

Notes. Smith (1819) described *Zornia latifolia* based on Aublet's collections from French Guiana (1775: 774) and cited *Hedysarum diphyllum* L. in synonymy. In his treatment of *Zornia*, Mohlenbrock (1961) did not refer to any type material for *Z. latifolia*, and synonymized *Z. gracilis* to *Z. latifolia*. Later, Sciamarelli and Tozzi (1996) cited the material *Perrottet 18* as the type of *Z. latifolia*, but this material refers to the taxon *Z. gracilis*. In our study of the collections at P, we located Aublet's material (Aublet, 1775), which Smith cited as type in his original description of *Z. latifolia*, and have properly cited the holotype here.

Through examination of the type of *Zornia gemella*, it was possible to confirm the species as *Z. latifolia*. When Vogel (1838: 61) described the species *Z. gemella*, he based it on Brazilian material that Willdenow identified as *Hedysarum gemellum* Willd. ex Vogel (an invalid name), citing the collections of *Sieber s.n.* (Pará, Brazil) and *Luschnath s.n.* (Bahia, Brazil). In the same work, Vogel (1838) described the new species *Z. ovata* Vogel, *Z. perforata*, *Z. trachycarpa* Vogel, and *Z. brasiliensis*. In all of these, he put the letter *n* after the species name, to identify the taxa as a new species. In relation to *Z. gemella*, Vogel (1838: 61) cited a collection of Willdenow (*H. gemellum* Willd. ex

Vogel) with the number 13777 (which was typed erroneously by him). The collection B-W 13777 deposited at Berlin (Willdenow Herbarium) corresponds to *H. conjugatum* Willd. The correct number of *H. gemellum* deposited at B (Willdenow Herbarium) is B-W 13778, and this is properly cited as the holotype of *Z. gemella* here.

Mohlenbrock (1961) did not observe the type collection of *Zornia gemella* and accepted it as distinct from *Z. latifolia*. Moreover, he described the new species *Z. curvata* Mohlenbr., which differed from his concept for *Z. gemella* on the basis of its curved loments.

Mohlenbrock (1961) recognized the variety *Zornia latifolia* var. *bernardinensis* (Chodat & Hassl.) Mohlenbr., distinguishing it from the typical variety by the upper leaflets being ovate (vs. lanceolate in *Z. latifolia* var. *latifolia*), punctate, 3- or multi-nerved (vs. 1- to 2-nerved), and generally glabrous on one or both faces (vs. indumented on both faces), as well as by the punctate bracts. However, these characteristics are not consistent, since *Z. latifolia* presents similar characteristics. The variation observed in *Z. latifolia* does not justify the maintenance of the variety *bernardinensis*, and the varietal name is synonymized here.

In their original description of *Zornia diphylla* var. *bernardinensis*, Chodat and Hassler (1904) cited two collections as type (*Hassler 3502* and *6035*), and lectotypification is needed. We have chosen the collection *Hassler 3502* as lectotype because it is the first material cited by Chodat in the protologue and it corresponds with the original description.

The name *Zornia maranhamensis* G. Don was considered by Mohlenbrock (1961) as a synonym of *Z. reticulata*. However, our observations of the type material support this as affiliated with *Z. latifolia*, based on its linear bracteoles that lack auricles as seen in *Z. latifolia*.

8. Zornia multinervosa Burkart ex Bacigalupo, Darwiniana 21(1): 174–176. 1977 [1978]. TYPE: Argentina. Entre Ríos: Federación, 14 Dec. 1974, *A. Burkart et al. 30855* (holotype, SI; isotype, CTES).

Zornia reticulata Sm. var. *neurada* Vogel, Linnaea 12: 58. 1838, syn. nov. TYPE: Brazil. s.d, *F. Sellow s.n.* (holotype, K).

Notes. Mohlenbrock (1961) did not treat the taxon *Zornia reticulata* var. *neurada* Vogel in his work. However, our analysis of the type material clearly indicates that the variety corresponds to *Z. multinervosa*, since the variety had the calyces with 38 or more nerves, and the name is synonymized here.

9. Zornia myriadena Benth., Fl. Bras. (Martius) 15(1): 85. 1859. TYPE: Brazil. Bahia, s.d., *Martius s.n.* (lectotype, designated here, M).

Notes. Mohlenbrock (1961) erroneously cited material from Jamaica (*Desvaux s.n.*) for the type of *Zornia myriadena*. However, Bentham (1859: 85) cited several syntypes from collections attributed to Martius, Luschnath, Blanchet (*897*, the only numbered collection mentioned), Saint-Hilaire, and Salzmann, and further noted "nec in Jamaica." Analyzing this group, the collection *Martius s.n.* most closely resembles the original description and is selected here as lectotype. This material presents all characters described in the protologue, such as the solitary flower and the leaflets obovate to elliptic with a retuse apex. *Martius s.n.* is from the first type locality mentioned by Bentham, "[h]abitat prope Bahiam in ruderatis ad vias," and is the first of four syntypes noted from Bahia.

10. Zornia reticulata Sm., Cycl. (Rees) 39: 205. 1818. TYPE: Jamaica. s.d., *D. J. Browne s.n.* (lectotype, designated here, LINN 921.23).

Hedysarum bifolium Vell., Fl. Flumin. 318. 1825 [1829], syn. nov. TYPE: Brazil. "Habitat inter gramina pascuis Regii Praedii Sanctae Crucis" [Vellozo, 1827: tab. 147] (lectotype, designated here, tab. 147 in Vellozo, 1827 [1831]).

Zornia diphylla (L.) Pers. subsp. *cuyabensis* Malme, Ark. Bot. 23A(13): 75. 1931. TYPE: Brazil. Mato Grosso: Cuiabá, 23 Nov. 1902, *G. O. A. Malme 2611a* (holotype, S).

Zornia diphylla (L.) Pers. subsp. *subperforata* Malme, Ark. Bot. 23A(13): 26. 1931. TYPE: Brazil. Rio Grande do Sul, Nov. 1901, *G. O. A. Malme 114a* (holotype, S).

Zornia diphylla (L.) Pers. f. *intermedia* Chodat & Hassl., Bull. Herb. Boissier, ser. 2, 4: 888. 1904. TYPE: Paraguay, Dec. 1898–1899, *E. Hassler 5912* (holotype, G; isotypes, BM, K, P).

Zornia diphylla (L.) Pers. var. *paraguariensis* Chodat & Hassl., Bull. Herb. Boissier, ser. 2, 4: 887. 1904. TYPE: Paraguay, 1898–1899, *E. Hassler 5115* (holotype, G; isotypes, BM, F, K, W).

Zornia diphylla (L.) Pers. f. *ciliata* Chodat & Hassl., Bull. Herb. Boissier, ser. 2, 4: 887. 1904. TYPE: Paraguay. "In campo pr. lacus Ypacaray," Dec., *E. Hassler 3700* (lectotype, designated here, G; duplicates, BM, F, K, W).

Zornia diphylla (L.) Pers. var. *rupestris* Chodat & Hassl., Bull. Herb. Boissier, ser. 2, 4: 888. 1904. TYPE: Brazil. 1900, *E. Hassler 6453* (holotype, G; isotypes, BM, P, W).

Zornia diphylla (L.) Pers. f. *diversifolia* Chodat & Hassl., Bull. Herb. Boissier, ser. 2, 4: 887. 1904, syn. nov. TYPE: Paraguay. Nov. 1898 1899, *E. Hassler 3449* (holotype, G; isotype, BM).

Zornia ovata Vogel, Linnaea 12: 58. 1838, syn. nov. TYPE: Brazil. Minas Gerais: Datas, 28 Oct. 2006, *A. P. Fortuna-Perez et al. 125* (neotype, designated here, UEC).

Zornia diphylla (L.) Pers. var. *pubescens* (Kunth) Benth., Fl. Bras. (Martius) 15(1): 82. 1859, syn. nov. Basionym: *Zornia pubescens* Kunth, Nov. Gen. Sp. (quarto ed.) 6: 515. 1823. TYPE: Colombia. Fusagasuga, s.d., *A. J. A. Bonpland & F. W. H. A. von Humboldt s.n.* (holotype, B, B-W 13775).

Zornia reticulata Sm. var. *punctata* Vogel, Linnaea 12: 58. 1838, syn. nov. TYPE: Brazil. s.d., *F. Sellow s.n.* (holotype, K).

Notes. When Smith (1818: 205) described *Zornia reticulata*, he stated "Our specimens are from Browne himself," and he cited the following collection: "*Hedysarum diphyllum* β; Willd. Sp. Pl. v. 3. 1178. δ; Lamarck v. 6.404. *H. diphyllum*; Swartz Obl. 285. H. n. Browne Jam. 301, excluding the synonyms. *H.* minus *diphyllum*, floreo luteo; Sloane Jam. v. 1. 185." According to Dandy and Milne-Redhead (1963), Smith (1818) possessed the Linnaean Herbarium, which contained Patrick Browne's plants purchased by Linnaeus in 1758. The sheet 921.23 that is deposited in the LINN Herbarium was annotated by Smith as "*Zornia reticulata* Sm. in Rees's Cyclop. [β] Willd." and annotated by Linneaus as "*Hedysarum diphyllum*." However, in his treatment, Mohlenbrock (1961) mistakenly established a neotype (*Harris 12070* [US], from Jamaica), most likely because he did not find any material of the type collection.

Dandy and Milne-Redhead (1963) also cited LINN 921.23 as the type of *Zornia reticulata*. However, as Smith (1819) cited various collections, the sheet 921.23 in the LINN Herbarium is being designated here as lectotype.

Five species are newly synonymized here with *Zornia reticulata*: *Z. diphylla* var. *pubescens* and *Z. ovata*, which were treated by Mohlenbrock (1961) as synonymous with *Z. latifolia* and *Z. sericea* Moric., respectively; *Z. reticulata* var. *punctata*; *Z. diphylla* f. *diversifolia*; and *Hedysarum bifolium*, which was described by Vellozo (1825). When Mohlenbrock (1961) considered the taxa *Z. diphylla* var. *pubescens* and *Z. pubescens* as synonyms of *Z. latifolia*, his explanation was limited to "*Z. pubescens* is merely an exceptionally hairy form of *Z. latifolia*." However, our observations of the type material of *Z. diphylla* var. *pubescens* support this taxon as affiliated with *Z. reticulata* based on the lanceolate to elliptic-lanceolate (to oval-lanceolate) bracteoles seen in *Z. reticulata*, while *Z. latifolia* has linear bracteoles.

When Vogel (1838: 58) described *Zornia ovata*, he mentioned that it was between *Z. reticulata* and *Z. perforata* (synonymous with *Z. glabra*). The original description of *Z. ovata* really represents a morphological variation found in *Z. reticulata*, differing widely from *Z. sericea*.

Because none of Sellow's material that corresponded to *Zornia ovata* has been located, the type (Brazil. "Hab. in Bras. merid.," s.d., *F. Sellow s.n.*), which was deposited at B, is presumed destroyed and a neotype is proposed for the name here. The chosen material (Fortuna-Perez et al., 125, UEC) was collected in Minas Gerais and presents morphological aspects that are representative of *Z. ovata*.

In relation to *Hedysarum bifolium* Vell., the correct procedure is to lectotypify the plate from the later companion series *Florae Fluminensis Icones*, which was issued after the text of *Florae Fluminensis*. There are no specimens extant that can be linked to a type for this Vellozo name, and indeed for many names in *Florae Fluminensis*. It can be assumed that the plate is the surviving indication of the original describing author's intent (McNeill et al., 2006: Art. 9.10). The original description of *H. bifolium* in *Florae Fluminensis* gives a precise locality for the type, but the plate was likely based on a collection that was lost some time ago. The plate and that lost specimen would be considered syntypes, and therefore lectotypification fixes the application of the name, as opposed to an alternate interpretation that the plate should serve as the holotype.

When Chodat and Hassler (1904) described *Zornia diphylla* f. *ciliata* (*Z. diphylla* var. *paraguariensis* f. *ciliata*), they cited three of Hassler's collections (*8176*, *5693*, and *3700*). We have chosen to lectotypify the collection *3700* because this material is complete and agrees with the original description of the taxon. In the same work, Chodat and Hassler (1904) described *Z. diphylla* f. *diversifolia* (*Z. diphylla* var. *stricta* f. *diversifolia*), and in this study, we consider it to be a synonym of *Z. reticulata*.

11. Zornia sericea Moric., Pl. Nouv. Amer. 126–127. 1844. TYPE: Brazil. Bahia: Jacobina, s.d., *J. S. Blanchet 2690* (lectotype, designated here, G; duplicates, BM, K, NY, P, W).

Notes. Vanni (1995) did not accept the name *Zornia sericea* Moric. because it is a name a posteriori of *Z. ovata* Vogel (Vogel, 1838). However, in this study, *Z. ovata* is considered a synonym of *Z. reticulata* and, therefore, excluded from circumscription of *Z. sericea*, which is reestablished here. *Zornia sericea* differs from *Z. reticulata* in its ovate bracteoles (vs. lanceolate), the length of the auricles at the bracteole (0–3 mm vs. 6–10 mm), three to four

articles per loment (vs. five to 10), and the articles 3–4 mm long (vs. 1.5–2.5 mm).

In his original description of *Zornia sericea*, Moricand (1844) cited the collections *Blanchet 2690* and *Blanchet 3873*. In his treatment of *Zornia*, Mohlenbrock (1961) cited *Blanchet 2690* as neotype. However, the correct procedure would be the lectotypification of one of these syntypes, and we have therefore designated a lectotype here. The collection *Blanchet 2690* is complete, has both flowers and fruits, and the habit corresponds to the original description and the plate.

12. Zornia trachycarpa Vogel, Linnaea 12: 60. 1838. *Zornia diphylla* var. *trachycarpa* (Vogel) Benth., Fl. Bras. (Martius) 15(1): 82. 1859. TYPE: Brazil. "In Brasil. merid.," s.d., *F. Sellow s.n.* (holotype, K).

Zornia linearifoliolata N. F. Mattos, Loefgrenia 90: 1. 1986, syn. nov. TYPE: Brazil. Rio Grande do Sul: Viamão, 22 Feb. 1984, *S. T. S. Miotto, M. Sobral & J. Waechter 938* (holotype, ICN).

Notes. *Zornia linearifoliolata* was described as different from *Z. trachycarpa*, distinguished by its upper leaflets linear, 15–25 mm long (vs. leaflets linear to lanceolate, 12–65 mm long in *Z. trachycarpa*). However, *Z. trachycarpa* includes these characteristics. Our analysis of the type material confirmed that this species is, in fact, *Z. trachycarpa*.

13. Zornia villosa (Malme) Herter, Revista Sudamer. Bot. 7: 210. 1943. Basionym: *Zornia latifolia* var. *villosa* Malme, Ark. Bot. 23A(13): 24, fig. 2. 1931. TYPE: Argentina. Misiones: Posadas, Bonpland, 11 Jan. 1908, *E. L. Ekman 1700* (holotype, NY; isotype, S).

Zornia vestita Mohlenbr., Webbia 16(1): 97. 1961, syn. nov. TYPE: Brazil. São Paulo: Itirapina, 22 Jan. 1951, *G. A. Black 51-11117* (holotype, IAN).

Notes. Mohlenbrock (1961) proposed that the name established by Herter (1943), *Zornia villosa* (Malme) Herter, taxonomically represented *Z. lanata*. The epithet for *Z. villosa* had been previously used by Glaziou (1906) to designate another species, which is treated herein as *Z. glaziovii* Harms. However, Glaziou's *Z. villosa* was a nomen nudum and was not validly published (McNeill et al., 2006: Rec. 50B.1). The binomial *Z. villosa* remains available and is recognized here; the name *Z. lanata* Mohlenbr. was not nomenclaturally necessary and should be rejected.

Zornia vestita is very similar morphologically to *Z. villosa* and has sympatric distribution. Our analysis of the type material clearly indicates that *Z. vestita* corresponds to variation accepted for *Z. villosa*.

14. Zornia virgata Moric., Pl. Nouv. Amer. 131–132. 1844. TYPE: Brazil. s.d., *M. Gardner s.n.* (holotype, G).

Zornia paniculata N. F. Mattos, Loefgrenia 63: 1. 1975. TYPE: Brazil. São Paulo: Luiz Antônio, Oct. 1967, *M. Kuhlmann s.n.* (holotype, SP 115685).

Zornia virgata Moric. var. *major* Hoehne, Exped. Roosevelt-Rondon, Bot. 2, Bot. 48, pl. 6. 1914, syn. nov. TYPE: Brazil. Mato Grosso: Serra do Tapirapoan, Jan. 1914, *F. C. Hoehne 5638* (holotype, R).

Notes. Moricand (1844: 131) described the species *Zornia virgata*, noting "Hab. in Brasilia e Gardnerianis sed (schedulá deperdita) locus natalis incertus." Gardner's unique type is deposited at G. However, Mohlenbrock (1961) erroneously cited the collection *Martius 1116* as the type for *Z. virgata*, which was the only material examined by Bentham (1859) and lacked type status.

Hoehne (1914) established a new variety for *Zornia virgata*, justifying that this differed from the typical variety by having more translucent dots in the bracteoles. However, our detailed study revealed that this characteristic occurs throughout the species, varying only in the number of glands. The type material has been located in the herbarium at R, and through the analyses of the type material and the description it is possible to verify that this variety is in fact *Z. virgata*. The variation observed in this study in *Z. virgata* does not justify the maintenance of the variety *major*, and it is therefore synonymized here.

New Combination

15. Zornia vichadana (Killip ex Mohlenbr.) Fort.-Perez & A. M. G. Azevedo, comb. et stat. nov. Basionym: *Zornia pardina* Mohlenbr. var. *vichadana* Killip ex Mohlenbr., Webbia 16(1): 87. 1961. TYPE: Colombia. El Vichada, 1 May 1939, *O. Haught 2797* (holotype, US).

Notes. Mohlenbrock (1961) established *Zornia pardina* var. *vichadana* based on material of *Z. diphylla* var. *vichadana* Killip, which was not validly published, being an in sched. name (nom. nud.). This variety is elevated to species level here because it possesses characteristics that support it as a well-defined species, such as the lack of auricles at the bracteoles and the absence of a vinaceous pigment in the bracteoles and leaflets.

Mohlenbrock (1961) also established *Zornia pardina* var. *crinita* Mohlenbr., but Vanni (1981)

elevated this variety to *Z. crinita* (Mohlenbr.) Vanni. *Zornia vichadana* is characterized by the presence of lanceolate bracteoles and the absence of auricles at the bracteoles, while *Z. pardina* and *Z. crinita* present oval to lanceolate bracteoles with auricles at the bracteoles.

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A New Species of *Gaultheria* (Ericaceae) from Mount Kinabalu, Borneo, Malaysia

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Abstract. We describe *Gaultheria paucinervia* P. W. Fritsch & C. M. Bush (Ericaceae: Gaultherieae), a new species apparently restricted to the eastern slopes of Mt. Kinabalu in Sabah State, Borneo, Malaysia. This species has been confused with *G. borneensis* Stapf, but differs in its more erect habit and larger stature, longer nonappressed leaf trichomes, purple (vs. white) fruiting calyx, and lower elevation range, among other features. The two species are furthermore well separated in molecular phylogenetic analyses, with *G. paucinervia* grouping in a clade of other eastern Asian species sharing whitish green abaxial leaf surfaces, racemose inflorescences, and a fleshy calyx surrounding a dry capsule.

Key words: Borneo, Ericaceae, *Gaultheria*, IUCN Red List, Kinabalu National Park, Malaysia, Mt. Kinabalu.

Gaultheria borneensis Stapf (Ericaceae) is known from Malaysia (Mt. Kinabalu, Borneo), the Philippines (Luzon), and Taiwan, ranging in elevation from 1600 to 4000 m (Sleumer, 1967; Fang & Stevens, 2005). During fieldwork on Mt. Kinabalu in Kinabalu National Park of Sabah State, Borneo, Malaysia, in July of 2009, we collected what has been anecdotally considered a lower-elevation element of *G. borneensis* restricted to Mt. Kinabalu (Sleumer, 1967). The plants comprising this element, occurring between 2440 and 2750 m elevation, were distinguished from those of *G. borneensis* occurring at higher elevations on Mt. Kinabalu (3350–4000 m) by their larger and more erect habit, larger leaves, one to five racemes from the upper leaf axils (vs. only one), and a purple (vs. white) fruiting calyx (Sleumer, 1967). We have been able to examine herbarium material annotated as *G. borneensis* from CAS and on loan to the first author from BM, E, and K, comprising 51 specimens collected from throughout the known geographic range of the species. This material included the holotype of *G. borneensis* (Stapf, 1894: 190, t. 15C, 4–6, Malaysia. Sabah: Mt. Kinabalu, 12,000 ft., *G. D. Haviland 1085* [holotype, K]) and five collections of the lower-elevation Mt. Kinabalu element; the latter includes one specimen annotated by H. O. Sleumer in 1962 as the "special form at lower altitudes" (*P. Collenette 633*, K). Based on the many morphological differences between the lower-elevation Mt. Kinabalu element and the other specimens of *G. borneensis* from throughout the range of the species, as well as a DNA-based phylogenetic study of *Gaultheria* Kalm ex L. in which samples of the lower-elevation Mt. Kinabalu plants and a sample of *G. borneensis* from the Philippines (*S. P. vander Kloet 2101092*, ACAD) are recovered in distinct clades (Fritsch et al., 2011), we describe this element as a new species.

Gaultheria paucinervia P. W. Fritsch & C. M. Bush, sp. nov. TYPE: Malaysia. Sabah [Borneo]: Ranau Distr., Kinabalu Natl. Park, along Mesilau Trail, 6.04062°, 111.56639°, 2488 m, 6 July 2009, *P. W. Fritsch, C. M. Bush, Y. Johalin & M. R. B. Salleh 1860* (holotype, SNP; isotypes, CAS, WFU). Figures 1, 2.

Haec species a *Gaultheria borneensi* Stapf habitu erecto 0.3 2.4 m alto, lamina foliari 1.8 2.4 × 0.6 1 cm, trichomatibus ramuli laminaeque adpressis vel ascendentibus eglandulosis usque ad 0.7 mm longis, racemis 1 vel 2 (ad 5) in quoque ramulo, pedicellis erectis, bracteolis carinatis margine glanduloso-serratis, lobis calycis 2 2.5 × 1.7 2 mm intra dense hirtellis atque calyce sub fructu purpureo differt.

Shrubs 0.3–2.4 m tall, terrestrial, erect, evergreen, many-branched; young branchlets brown (green or strongly flushed with red when fresh), smooth, white-puberulent and with scattered ascending-uncinate black setae. Petiole 0–3.5 mm, red when fresh; leaf blades elliptic to slightly oblanceolate, 1.8–2.4 × 0.6–1 cm, smaller distally along branches and sometimes grading into inflorescence bracts, 2.4–

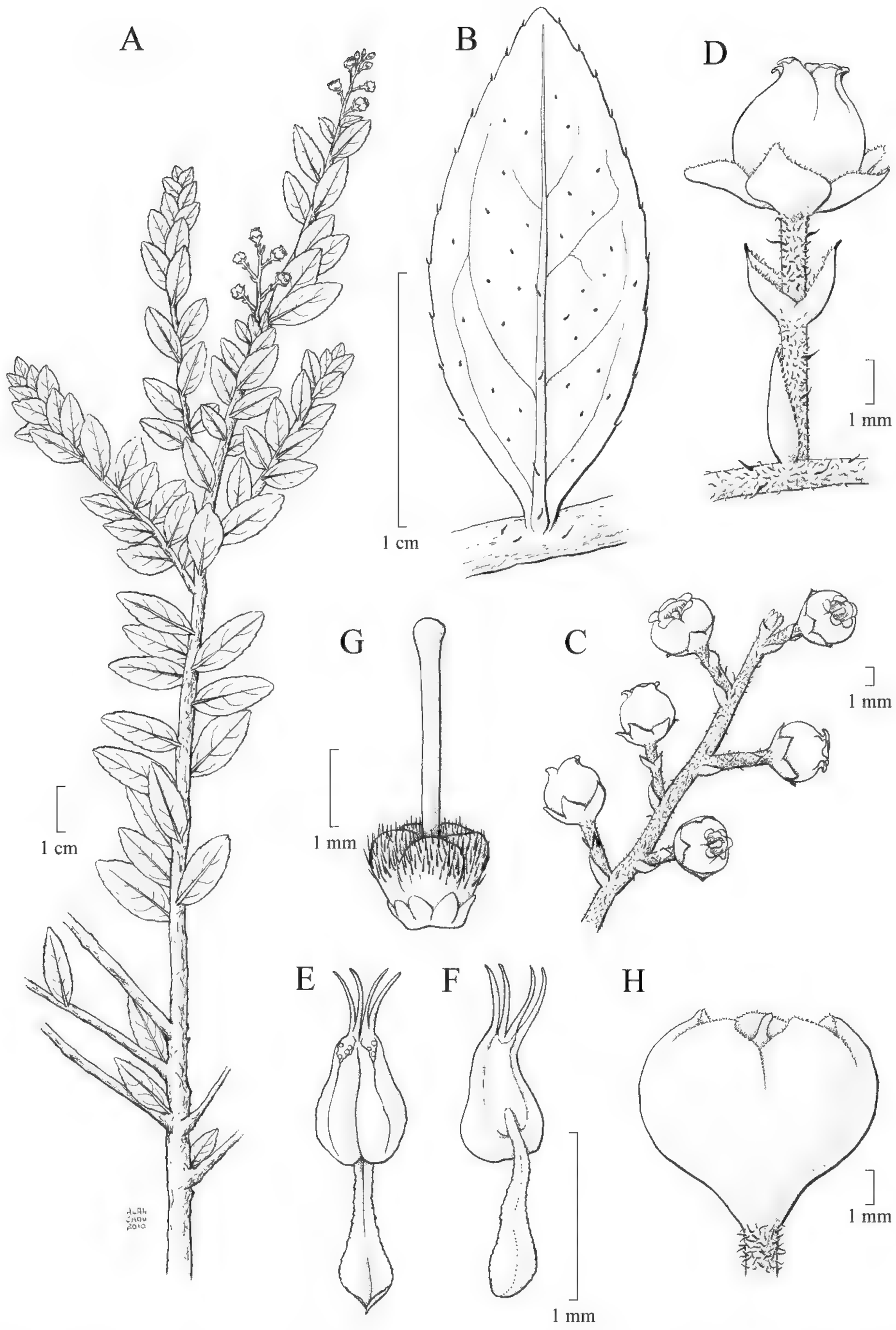

Figure 1. *Gaultheria paucinervia* P. W. Fritsch & C. M. Bush. —A. Flowering branch. —B. Branchlet segment and leaf. —C. Inflorescence. —D. Rachis segment, pedicel, and flower. —E. Stamen, ventral view. —F. Stamen, dorsal view showing central region of distintegration tissue. —G. Gynoecium and basal nectary glands. —H. Fruit. A, B drawn from the isotype *P. W. Fritsch et al. 1860* (CAS); C–G from *G. Argent 1643* (E); H from *W. L. Chew & E. J. H. Corner 7146* (K).

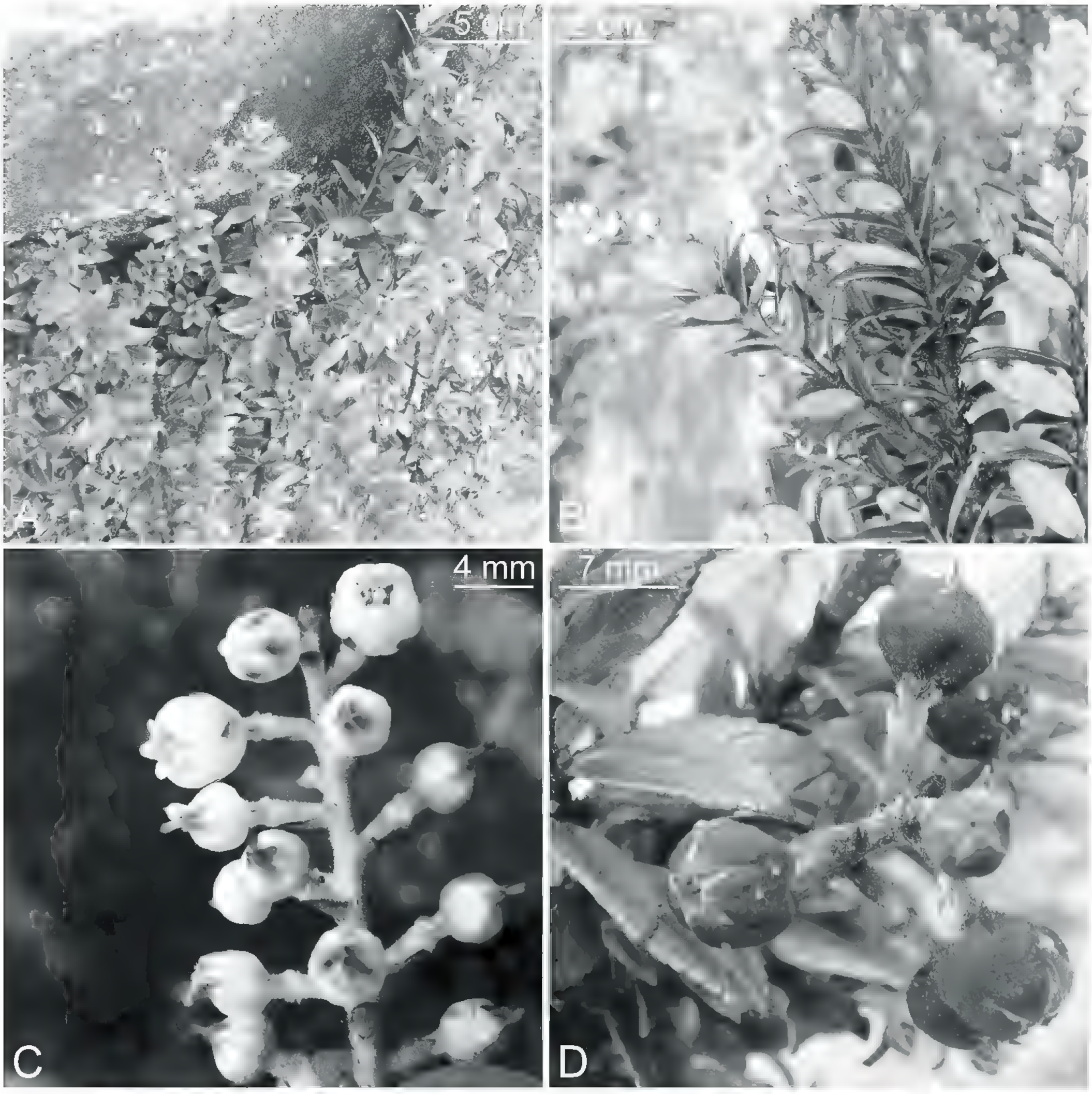

Figure 2. *Gaultheria paucinervia* P. W. Fritsch & C. M. Bush. —A. Habit. —B. Branchlets with flower buds and young fruit. —C. Inflorescence. —D. Fruit. A–D from the isotype *P. W. Fritsch et al. 1860* (CAS). Photographs by P.W.F.

4.2× as long as wide, subcoriaceous, with strong wintergreen odor when crushed, abaxially greenish white or light to dark brown (greenish white except for red base along midvein when fresh), red to black punctate, the punctae often bearing antrorsely appressed or ascending nonglandular-tipped setae of various lengths to 0.7 mm, adaxially dull green, basally white-puberulent and also with scattered dark glandular hairs especially along midvein, midvein abaxially raised, adaxially slightly so, secondary veins arcuate, 2(3) on each side of midvein, only the distalmost pair reaching leaf apex, abaxially raised, adaxially slightly impressed, planar, or obscure, tertiary veins abaxially raised, adaxially obscure, base cuneate, margin flushed with red when fresh, revolute, serrulate throughout with 10 to 14 teeth per side, marginal setae to ca. 0.3 mm, apex retusely glandular-acute. Inflorescences terminal, racemose, 1 or 2(to 5) per branchlet, when multiple then together appearing paniculate and branched near base, 2–4 cm long, 9- to 15-flowered; rachis densely white-villulose and sometimes sparsely setulose; bracts oblong-lanceolate, linear-lanceolate, or ± spatulate, not keeled, 4–5.5 × 1–1.2 mm, smaller distally, persistent, abaxially glabrous or puberulent, sometimes also setulose, adaxially puberulent, glandular-serrate and sometimes white-ciliate, apex glandular-acute; pedicels 4–5 mm (somewhat longer in fruit), erect, white-villulose; bracteoles borne on middle of pedicel, ovate-deltoid,

keeled, 1.5–2 × 1.2–1.5 mm, otherwise similar to bracts. Calyx 3–4 mm; lobes 5, white tipped with dark pink, ovate, 2–2.5 × 1.7–2 mm, outside glabrous, inside densely hirtellous, not keeled, margin ciliate, apex acuminate-aristate; corolla white, globose-urceolate, 4–4.5 × 3–3.5 mm, glabrous outside and inside; lobes 5, oblong or oblong-deltoid, 0.7–1.5 mm; stamens 10; filaments 1.2–1.4 mm, slightly dilated proximally, papillose especially along margins, otherwise glabrous; anthers 1–1.2 mm, with white disintegration tissue dorsally, awns 2 per theca, 0.5–0.6 mm; ovary densely white-hirtellous; style 1.5–2.5 mm, glabrous. Fruiting calyx red when immature, purple at maturity, fleshy; lobes erect to reflexed when dry, not pale-edged; capsule 5–7 mm diam.; seeds oblique-pyramidal, shallowly areolate, ca. 0.8 mm.

Distribution and habitat. *Gaultheria paucinervia* is known only from the eastern slopes of Mt. Kinabalu from ca. 2350 to 2750 m elevation, occurring in the primary upper montane rainforest zone, where it grows on granitic ridges in open shrubby areas on clay.

IUCN Red List category. *Gaultheria paucinervia* has apparently been collected only in a protected area of Kinabalu National Park along the Mesilau Trail, which traverses part of the eastern escarpment of Mt. Kinabalu. Assuming the species is endemic to the eastern slopes and shoulder of Mt. Kinabalu within the elevational ranges recorded for the species, we estimate the area of occupancy as ≤ 20 km^2. At the type locality along the Mesilau Trail, we could only find several plants clustered at the base of a large rock in a forest opening. Based on IUCN Red List criteria (IUCN, 2001), we assign a preliminary status of Vulnerable (VU D2).

Phenology. *Gaultheria paucinervia* has been collected in flower in March, April, July, and December, and in fruit in March and July.

Etymology. The specific epithet of this new species is taken from the Latin and refers to the small number of secondary veins on the leaf blades relative to most other species of *Gaultheria*.

Discussion. Airy Shaw (1941) considered *Gaultheria borneensis*, *G. cuneata* (Rehder & E. H. Wilson) Bean, *G. prostrata* W. W. Sm., *G. pyroloides* Miq., and *G. pyrolifolia* Hook. f. ex C. B. Clarke to be close relatives based on a shared ± sympodial relation of the inflorescence to the main vegetative axis. These species are all diminutive prostrate shrubs with small leaves and a white fruiting calyx except for *G. pyrolifolia*, in which the fruiting calyx is purple (Fritsch & Trock, 2007; Fritsch et al., 2008). The white-fruited species of this group all form a strongly supported Sympodial clade in molecular phylogenetic studies, whereas *G. pyrolifolia* groups within a large *Gaultheria* ser. *Leucothoides* [(Airy Shaw) D. J. Middleton] s.l. clade, as does a sample of our new species (Lu et al., 2010; Fritsch et al., 2011). It is unclear to us precisely what Airy Shaw intended by his use of sympodial in describing the relationships of these species, but this term may allude to the several prominent perulae alternately arranged toward the base of the inflorescence axis in the species of the Sympodial clade. *Gaultheria paucinervia* lacks these perulae, instead bearing leaves that undergo a gradual or abrupt transition to bracts distally along the length of the continuous branchlet and inflorescence axis.

We confirm the utility of characters used by Sleumer (1967) to delimit *Gaultheria borneensis* s. str. from his special form here called *G. paucinervia*, i.e., a prostrate shrub habit to 0.6 m tall (vs. an erect shrub to 2.4 m), leaf blades 0.8–1.5(–2) × 0.3–0.7 cm (vs. 1.8–2.4 × 0.6–1 cm), only one raceme per branchlet (vs. one to five), and a white fruiting calyx (vs. purple). In addition to the lack of inflorescence perulae, *G. paucinervia* is further distinguished from *G. borneensis* by the following characters: appressed, glandular-tipped branchlet and leaf trichomes to 0.3 mm long (vs. appressed to ascending, nonglandular-tipped, and to 0.7 mm long); lustrous leaf surfaces adaxially (vs. dull); pedicels recurved (vs. erect); bracteoles not keeled and with the margins not or only weakly glandular (vs. keeled and with the margins glandular-serrate); and calyx lobes 1–1.8 × 0.7–1.5 mm, strigillose or puberulent inside (vs. 2–2.5 × 1.7–2 mm, densely hirtellous inside).

On Mt. Kinabalu, *Gaultheria borneensis* occupies the acid thin organic soils of subalpine woodland or scrub under almost constant diurnal fog and humidity, whereas *G. paucinervia* occurs in upper montane rainforest where periodic droughts can occur and soils are deeper and have more clay content. Correlated with these habitat features, many woody species of the subalpine zone are lower in stature and have leaves that are adaxially smaller (often nanophyllous), concave, and more lustrous than relatives in the upper montane zone (Stapf, 1894; Kitayama, 1991; P. Ashton, pers. comm.). The two species of *Gaultheria* parallel the trends between habitat and morphology in these respects.

Gaultheria malayana Airy Shaw of Peninsular Malaysia and *G. paucinervia* form the sister group of a clade comprising *G. discolor* Nutt. ex Hook. f. and *G. straminea* R. C. Fang in phylogenetic studies (Lu et

al., 2010; Fritsch et al., 2011). These four species share leaf blades that are abaxially greenish white when fresh, a relatively uncommon feature in the larger *Gaultheria* ser. *Leucothoides* s.l. clade to which they belong. *Gaultheria malayana* is distinguishable from *G. paucinervia* by a longer petiole 5–10 mm (vs. 0–3.5 mm), leaf blades 3.5–6.5 × 1.5–4.7 cm (vs. 1.8–2.4 × 0.6–1 cm) with five (to seven) secondary veins on each side of the midvein (vs. two [or three]), and bracteoles borne on the apex of the pedicel (vs. on the middle).

The only Malesian species of *Gaultheria* with racemose inflorescences and bracteoles borne on the middle of the pedicel other than *G. borneensis* are *G. acroleia* Sleumer, *G. barbulata* Sleumer, *G. atjehensis* J. J. Sm., *G. dialypetala* Sleumer, and *G. solitaria* Sleumer (Sleumer, 1967). The first two species are distinguished from *G. paucinervia* by larger leaf blades at least 3 × 2 cm (vs. 1.8–2.4 × 0.6–1 cm), and the latter three by ovate leaf blades (vs. elliptic to slightly oblanceolate; Sleumer, 1967). *Gaultheria dialypetala* from Sumatra has yet to be sampled for molecular phylogenetic data and may be the closest relative of *G. paucinervia*, the two sharing a similarly short petiole (1–2 mm), small leaf blades (1–2 × 0.8–1.3 cm) with few secondary veins (usually three on each side of the midvein), glabrous corollas, merely papillose stamen filaments, and a densely pubescent ovary. In addition to its ovate leaf blades, the taxon differs from *G. paucinervia* by its prostrate habit 0.3–0.4 cm tall (vs. erect and 0.3–2.4 m), 1- to 5-flowered racemes (vs. 9- to 15-flowered), and a pubescent style (vs. glabrous).

Paratypes. MALAYSIA. **Sabah:** above Mesilau East River, ca. 6°03′N, 116°33′E, 2500 m, 4 Apr. 1980 (fl.), *G. Argent 1643* (E); Mentaki Ridge, 7800 ft., 17 Mar. 1964 (fl., fr.), *W. L. Chew & E. J. H. Corner 7146* (K); new rte. up Mt. Kinabalu (SE face), 9000 ft., 16 Dec. 1960 (fl.), *P. Collenette 633* (K); Mesilau rte., 8000 ft., 24 July 1963 (fl., fr.), *W. Meijer s.n.* (K).

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Hoya jianfenglingensis (Apocynaceae), a New Species from Hainan, China

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ABSTRACT. *Hoya jianfenglingensis* Shao Y. He & P. T. Li (Apocynaceae) is described as a new species from Hainan, China. The morphological characters of *H. jianfenglingensis* are illustrated and compared with the related species, *H. fungii* Merr. and *H. carnosa* (L. f.) R. Br. *Hoya jianfenglingensis* differs in its leaf indumentum, the prominent lateral veins in six to 10 pairs, the evident glands at the corona base, and the smaller corolla (only to 1.5 cm diam.). *Hoya jianfenglingensis* is assigned to section *Hoya* within the genus on the basis of the acute outer angle of the corona lobes.

Key words: Apocynaceae, China, Hainan, *Hoya*, *Hoya* sect. *Hoya*, IUCN Red List.

Hoya R. Br. is a medium-sized genus within the Apocynaceae with ca. 200 species and is widely distributed in tropical and subtropical areas from eastern Asia throughout the Pacific archipelago and Oceania. Twenty-two species, three varieties, and two forms were reported from China (Tsiang & Li, 1977), but Li et al. (1995) later considered 32 species and a single variety for the country, with *H. baishaensis* Shao Y. He & P. T. Li a recent addition to *Hoya* of China (He et al., 2009). Most species occur in Yunnan, Guangxi, and Hainan provinces, and there are 22 species with a white corolla in China. Recently, Forster and Liddle (1996) estimated the genus at over 300 species, distributed in Malaysia, New Guinea, and throughout the Philippines and western Pacific Islands, extending in Asia to include the Indian subcontinent. Six species are native to Australia, with one endemic and one naturalized. Jagtap and Singh (1999) reduced the species estimate to ca. 200 species distributed throughout the moister eastern tropics from Nepal and Ceylon to South China and northern Australia and in the Pacific region, with 29 species noted for India. Although Rintz (1978) agreed with Ridley (1923) on a species total of 25 *Hoya* in Malaysia, they significantly differed in five species. Only one species has been reported from Pakistan (Nasir & Ali, 1972).

During two expeditions to Jianfengling, Hainan, in the autumn of 2006 and summer of 2008, three undetermined specimens of *Hoya* with white corollas were collected by three of the authors. Based on comparison with herbarium specimens in CANT, HITBC, IBSC, and KUN, and study of the pertinent literature (Hooker, 1885; Costantin, 1912; Merrill, 1932; Nasir et al., 1972; Tsiang & Li, 1974, 1977; Rintz, 1978; Li, 1994; Gilbert et al., 1995; Li et al., 1995; Foster & Liddle, 1996; Lu et al., 1998; Jagtap & Singh, 1999), we determined that these collections did not correspond to previously described *Hoya*, and we describe the taxon as new here.

Hoya jianfenglingensis Shao Y. He & P. T. Li, sp. nov. TYPE: China. Hainan: Jianfengling,

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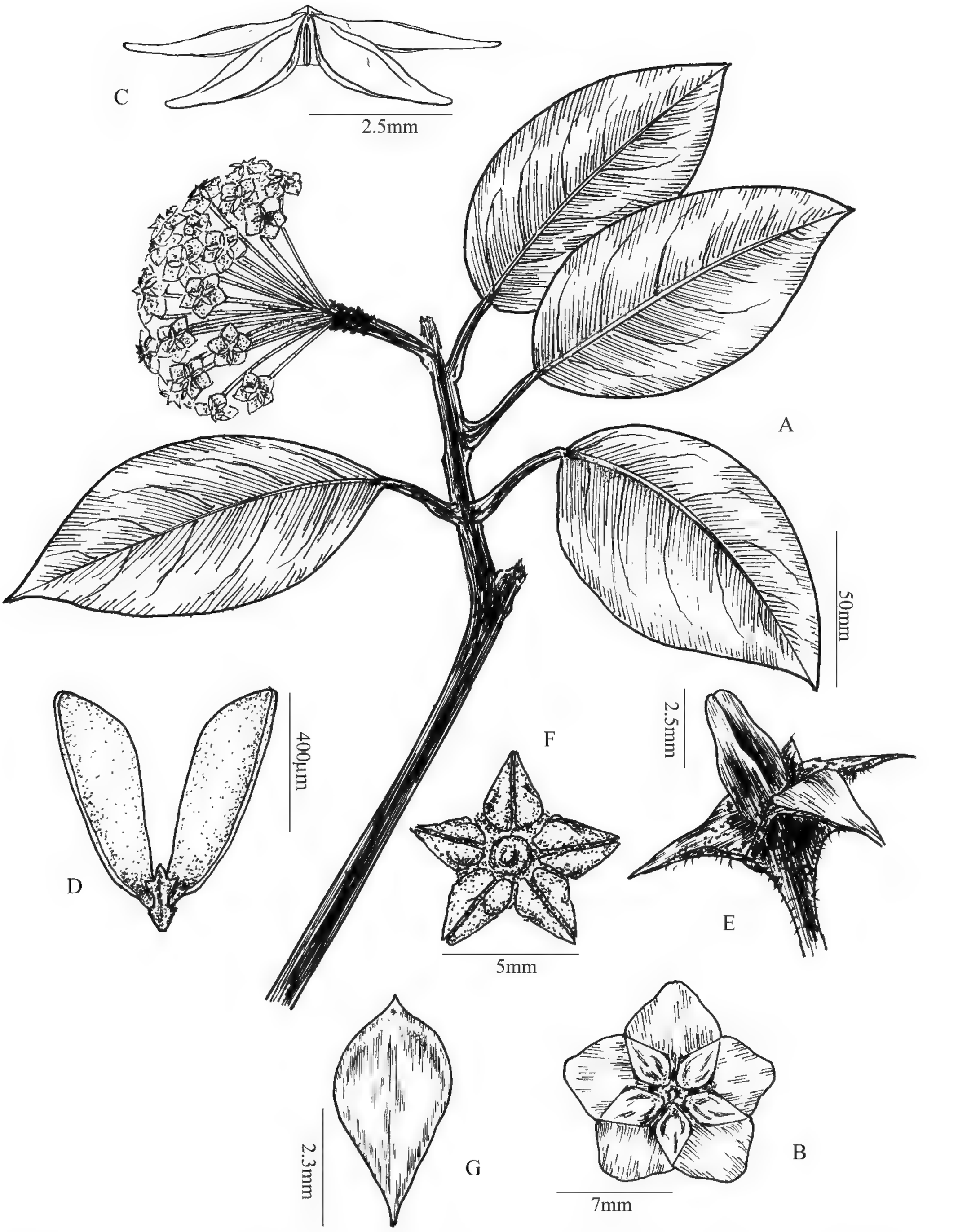

Figure 1. *Hoya jianfenglingensis* Shao Y. He & P. T. Li. —A. Flowering stem. —B. Apical view of flower. —C. Side view of corona. —D. Pollinarium. —E. Calyx and ovary. —F. Back view of corona. —G. Glandule at the base of corona scale. Drawn from the holotype *He et al. 0607281* (CANT).

18°44′N, 108°50′E, on tree in montane tropical rainforest, 1040 m, 28 July 2006, *Shao Y. He, P. Y. Li & J. Y. Lin 0607281* (holotype, CANT, CANT photo at MO). Figure 1.

Species *Hoyae fungii* Merr. affinis, sed ab ea caulibus robustis pubescentibus, foliis utrinque pubescentibus nervis lateralibus in 6 ad 10 paribus manifestis, corollis 1.3 1.5 cm diametro atque coronis rubris ad basim glanduliferis differt.

Table 1. Morphological comparison of *Hoya jianfenglingensis* and two similar species.

Characters	*H. carnosa*	*H. fungii*	*H. jianfenglingensis*
Indumentum	glabrous except for inflorescences	glabrous except for pedicel and calyx	pubescent on young stem, calyx, and leaf blade on both surfaces
Leaf shape	broadly ovate to ovate-oblong or elliptic	ovate, elliptic to elliptic-oblong	obovate or elliptic
Blade apex	obtuse or short acuminate	acute or short acuminate	acuminate
Blade base	rounded to shallowly cordate	rounded	round or broadly cuneate
Blade length	3.5–13 cm	8–20 cm	11–14 cm
Blade width	3–5 cm	4.5–9 cm	5–7 cm
Leaf venation	ca. 4 inconspicuous pairs	ca. 7 pairs evident	6 to 10 conspicuous pairs
Corolla diameter	1.5–2 cm	1.5–1.8 cm	1.3–1.5 cm
Corona color	red	light yellow	red
Glandules at corona base	no	no	yes
Distribution	China: Fujian, Guangdong, Guangxi, Hainan, Taiwan, Yunnan	China: Guangdong, Guangxi, Hainan, Yunnan	China: Jianfengling, Hainan

Epiphytic, high climbing to 8 m or more; stems branched, stout, hoary pubescent. Leaves opposite, rarely alternate; petioles 2–3 cm; leaf blades obovate or elliptic, 11–14 × 5–7 cm, thick and papery, leathery when dry, apex acuminate, base round or broadly cuneate, glandular, lateral veins obvious and in 6 to 10 pairs, pubescent on both surfaces. Inflorescences extra-axillary; peduncles pubescent, ca. 4 cm; pedicels 2–4 cm, with purple or purple-brown spotting. Flowers with the corolla inner surface covered with white tomentum, apex slightly reflexed, united toward the adnate base, corolla ca. 1.3–1.5 cm diam.; corona lobes fleshy, with glandules at the corona base, stellate, strongly valvate, lobes with an acute outer angle, with a hump above the middle that encloses a hollow space at the base, lobes with an acute inner angle, red in color, the lower surface channeled in the middle from the base to apex; ovaries glabrous, ca. 2.3 × 2 mm diam. Pollinia oblique, clavate, ca. 600 × 210 μm; caudicle small, ca. 90 × 30 μm. Retinaculum ca. 250 × 100 μm. Stigmas ca. 1.8 × 2 mm diam.

Distribution. *Hoya jianfenglingensis* is only known from the three collections from the type locality. Also in Hainan and potentially sympatric at higher elevations, *H. griffithii* Hook. f. and *H. lasiogynostegia* P. T. Li usually occur between 100 and 1100 m in Jianfengling of Hainan, where these taxa occur in similar humid forested habitats.

Habitat. *Hoya jianfenglingensis* thrives in tropical mountain rainforest, collected at an altitude of 1040 m. It was observed to grow on trees or rocks in the woods, where the microhabitats are humid and foggy. This plant community had a layered canopy dominated by *Ficus altissima* Blume (Moraceae), *Polyalthia consanguinea* Merr. (Annonaceae), *Schefflera octophylla* (Lour.) Harms (Araliaceae), and *Lindera robusta* (C. K. Allen) H. P. Tsui (Lauraceae). Vines and other epiphytes were *Tetrastigma planicaule* (Hook. f.) Gagnep. (Vitaceae) and *Ichnocarpus polyanthus* (Blume) P. I. Forst. (Apocynaceae); herbs included *Amorphophallus henryi* N. E. Br., *Zantedeschia aethiopica* (L.) Spreng., and *Scindapsus maclurei* (Merr.) Merr. & F. P. Metcalf (these three in Araceae); and ferns included *Pseudodrynaria coronans* (Wall. ex Mett.) Ching (Polypodiaceae) and *Neottopteris nidus* (L.) J. Sm. (Aspleniaceae).

IUCN Red List category. *Hoya jianfenglingensis* is endemic to Hainan, China. The new species is known only from the type collection and has an estimated area of occupancy of ca. 100 km² with a population of less than 60 individuals. Without further investigation, there is insufficient information to estimate the conservation status for *H. jianfenglingensis*, and its conservation status is assessed here as Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001).

Phenology. The new species was observed in flower in May and July; fruit and seed are as yet unknown.

Etymology. The specific epithet is derived from the type locality in Jianfengling, Hainan Province, China.

Discussion. *Hoya jianfenglingensis* closely resembles *H. fungii* Merr. and *H. carnosa* (L. f.) R. Br., sharing elliptic leaves and an acute outer angle of the corona lobes. The new species differs from the latter two in the presence of indumentum, the smaller

corolla diameter, and the presence of glandules on the basal corona (Table 1).

Paratypes. CHINA. **Hainan:** Jianfengling, 18°44′N, 108°50′E, on tree in montane tropical rainforest, 1040 m, 8 May 2008, *Shao Y. He 0805081* (CANT), *Shao Y. He 0805082* (MO).

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Senecio ser. *Chilenses*, a New Name for *Senecio* ser. *Suffruticosi* (Asteraceae, Senecioneae) from Southern South America

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Abstract. The name *Senecio* L. ser. *Chilenses* DC. ex M. G. López, A. F. Wulff & Xifreda is here validated to replace *Senecio* ser. *Suffruticosi* Cabrera, non *Senecio* sect. *Suffruticosi* Greenm. Although the epithet *Suffruticosi* was published at different infrageneric ranks within *Senecio* (Asteraceae, Senecioneae) for two different taxa from South and North America, respectively, the two epithets are considered homonyms. Series *Chilenses* was previously published by de Candolle, but without a description.

Resumen. El nombre *Senecio* L. ser. *Chilenses* DC. ex M. G. López, A. F. Wulff & Xifreda se valida aquí para reemplazar a *Senecio* ser. *Suffruticosi* Cabrera, non *Senecio* sect. *Suffruticosi* Greenm. A pesar de que el epíteto *Suffruticosi* fue publicado para definir rangos subgenéricos diferentes dentro *Senecio* (Asteraceae, Senecioneae) para dos taxa diferentes de América del Sur y del Norte, respectivamente, ambos epítetos son considerados homónimos. Series *Chilenses* fue publicado previamente por de Candolle pero sin una descripción.

Key words: Argentina, Asteraceae, Chile, *Senecio*.

Our studies on the Asteraceae of Andean high mountains have brought attention to the nomenclatural illegitimacy of the name *Senecio* L. ser. *Suffruticosi* Cabrera (Cabrera, 1985). It is a later homonym of *Senecio* sect. *Suffruticosi* Greenm. (Greenman, 1901), according to the *International Code of Botanical Nomenclature* (ICBN; McNeill et al., 2006: Art. 53.4). Therefore, we herein validate the new name, *Senecio* ser. *Chilenses* DC. ex M. G. López, A. F. Wulff & Xifreda in replacement.

The epithet *Suffruticosi* Greenm. for an infrageneric taxon in *Senecio* L. was first used by Greenman (1901) for 17 species from the United States and Mexico, and the epithet was published at the rank of section, validated by description in a key (Ediger, 1970). Greenman (1915) also recognized his section *Suffruticosi* in a synopsis of the subgenera and sections of *Senecio* in his monograph of the North and Central American species. Greenman's section was not based upon a type; nevertheless, *S. douglasii* DC. was recognized as a representative species (Ediger, 1970).

Independently, Cabrera (1949) published the similar name, *Senecio* sect. *Suffrutecius* Cabrera, for a group of a largely Andean and Patagonian species, based upon the type *S. chilensis* Less. Cabrera (1985) later reduced the taxon to the rank of series, publishing the new epithet *Suffruticosi* Cabrera, which, unlike the epithet *Suffrutecius*, was in better agreement with ICBN Art. 21.2, stating that the name of a subdivision of a genus be "a plural adjective agreeing in gender with the generic name" (McNeill et al., 2006: 42). Argument might be made that the epithet *Suffrutecius* (Cabrera, 1949) is an orthographical variant of *Suffruticosi*. However, as defined under Art. 53.3 (McNeill et al., 2006), an orthographical variant implies stringent criteria, with most cited examples differing by only one or two letters, and the two names by Greenman and Cabrera, respectively, are orthographically different. Moreover, Cabrera (1985: 194) published his series *Suffruticosi* as a new name, citing his previous section *Suffrutecius* as a synonym, without correction as "sect. Suffruticosi Cabrera, Lilloa 15: 101, 1049, 'Suffrutecius,'" in conformity with ICBN Rec. 50F (McNeill et al., 2006). In addition, later in Cabrera et al. (1999), he again cites "sect. *Suffrutecius* Cabrera (1949)," without correction, as a synonym of his series *Suffruticosi* (Cabrera, 1985).

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In summary, within *Senecio*, the epithet *Suffruticosi* Greenm. (1901) has priority over the epithet *Suffruticosi* Cabrera (1985) for an infrageneric taxon. Although the former was published at the rank of section and the latter at the rank of series, they are considered homonyms according to the ICBN (McNeill et al., 2006: Articles 53.4 and 21.1, Note 1). De Candolle's (1838) *Senecio* ser. *Chilenses* included *S. chilensis*, among other Chilean species. The series was not validly published and lacked a description, with only its geographical distribution noted. The name is herein validated as a new name for *Senecio* ser. *Suffruticosi* Cabrera (1985), and its type *S. chilensis* reflects de Candolle's taxonomic inclusion.

Senecio L. ser. **Chilenses** DC. ex M. G. López, A. F. Wulff & Xifreda, nom. nov. Replaced name: *Senecio* L. ser. *Suffruticosi* Cabrera, Darwiniana 26: 194. 1985, nom. illeg., non *Senecio* L. sect. *Suffruticosi* Greenm., Monogr. *Senecio* 22. 1901. *Senecio* L. ser. *Chilenses* DC., Prodr. 6: 415. 1837, nom. nud., sine descr. TYPE: *Senecio chilensis* Less.

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Musella lasiocarpa var. *rubribracteata* (Musaceae), a New Variety from Sichuan, China

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ABSTRACT. Taxonomic study of the diversity of *Musella lasiocarpa* (Franch.) C. Y. Wu ex H. W. Li (Musaceae) in China has revealed an attractive new variety from Sichuan Province, southwestern China. *Musella lasiocarpa* var. *rubribracteata* Zhenghong Li & H. Ma differs from the autonymic variety by its orange-red to red bracts, the reddish to purple-red coloration of the abaxial surfaces of the petiole and leaf midrib, and a weaker ability of clone reproduction.

Key words: China, IUCN Red List, Musaceae, *Musella*, Sichuan.

Musella lasiocarpa (Franch.) C. Y. Wu ex H. W. Li represents the monotypic genus *Musella* (Franch.) C. Y. Wu & H. W. Li in the family Musaceae (Li, 1978, 1979; Wu & Kress, 2000). The taxon is endemic to southwestern China, found primarily in central and northwestern Yunnan and southern Sichuan provinces. Morphologically, this taxon is the most easily recognizable one within the Musaceae, distinguished from *Musa* L. and *Ensete* Horan. by its dwarf, congested pseudostems less than 60 cm long, erect compact rosette inflorescences with yellow to yellow-orange bracts, and short, hirsute fruits not exceeding 5 cm. This attractive plant has been horticulturally introduced into various regions and botanical gardens around the world (Liu et al., 2002).

Musella lasiocarpa possesses a complex taxonomic history. It was first placed in *Musa*, then in *Ensete*, and then back in *Musa* before its monotypic status was eventually recognized (Cheesman, 1947; Simmonds, 1960; Li, 1978). Molecular systematics based on ITS and *trnL-F* sequence data supports the status of *Musella* as a monotypic genus (Liu, 2001). In addition, embryological features further prove that *Musella* should be a distinct genus (Xue et al., 2007).

Wild populations of *Musella lasiocarpa* have been known to exist on cliffs within the watershed of the upper Yangtze River and its tributaries, in northern Yunnan and southern Sichuan provinces in China. It is now difficult to find wild populations because appropriate habitats have been fragmented due to widespread cultivation. However, *M. lasiocarpa* is locally common in this region of southwestern China and is maintained as a semi-cultivated plant. This taxon is extensively used by farmers as fodder for livestock, for erosion control, and as weaving material. Plants have been utilized as an edible vegetable, as medicine, in wine making, and even as a resource for honey production (Liu et al., 2003; Long et al., 2008).

Considering the high ornamental value and endemism of *Musella lasiocarpa*, we have been committed to investigate the diversity of wild populations since 2004. To date we have documented eight wild populations and compared their genetic diversity with that of cultivated populations (Pan et al., 2007). As a corollary to our continued fieldwork, attractive plants of *Musella* with orange-red to red bracts, rather than the expected paler coloration of yellow to yellow-orange, were found in a single wild population in Panzhihua City, Sichuan Province. In association with other distinctive morphological characters, we conclude that these plants represent a new variety of *M. lasiocarpa*, which is described below.

1. Musella lasiocarpa (Franch.) C. Y. Wu ex H. W. Li, Acta Phytotax. Sin. 16(3): 56–57. 1978. Basionym: *Musa lasiocarpa* Franch., J. Bot. (Morot) 3(20): 330–331, fig. 1. 1889. *Ensete lasiocarpum* (Franch.) Cheesman, Kew Bull. 2(2): 102. 1947. TYPE: Fig. 1 in Franchet, 1889 (lectotype, designated by Häkkinen & Väre, 2008: 81).

1a. Musella lasiocarpa var. **lasiocarpa**.

Musella lasiocarpa var. *lasiocarpa* can be distinguished by its floral bracts that are yellowish green to yellow. These bracts can sometimes be orange near the margins. The petioles are light green or green, but seldom with a reddish tinge; the leaf blades are similarly green without red coloration. Plants of

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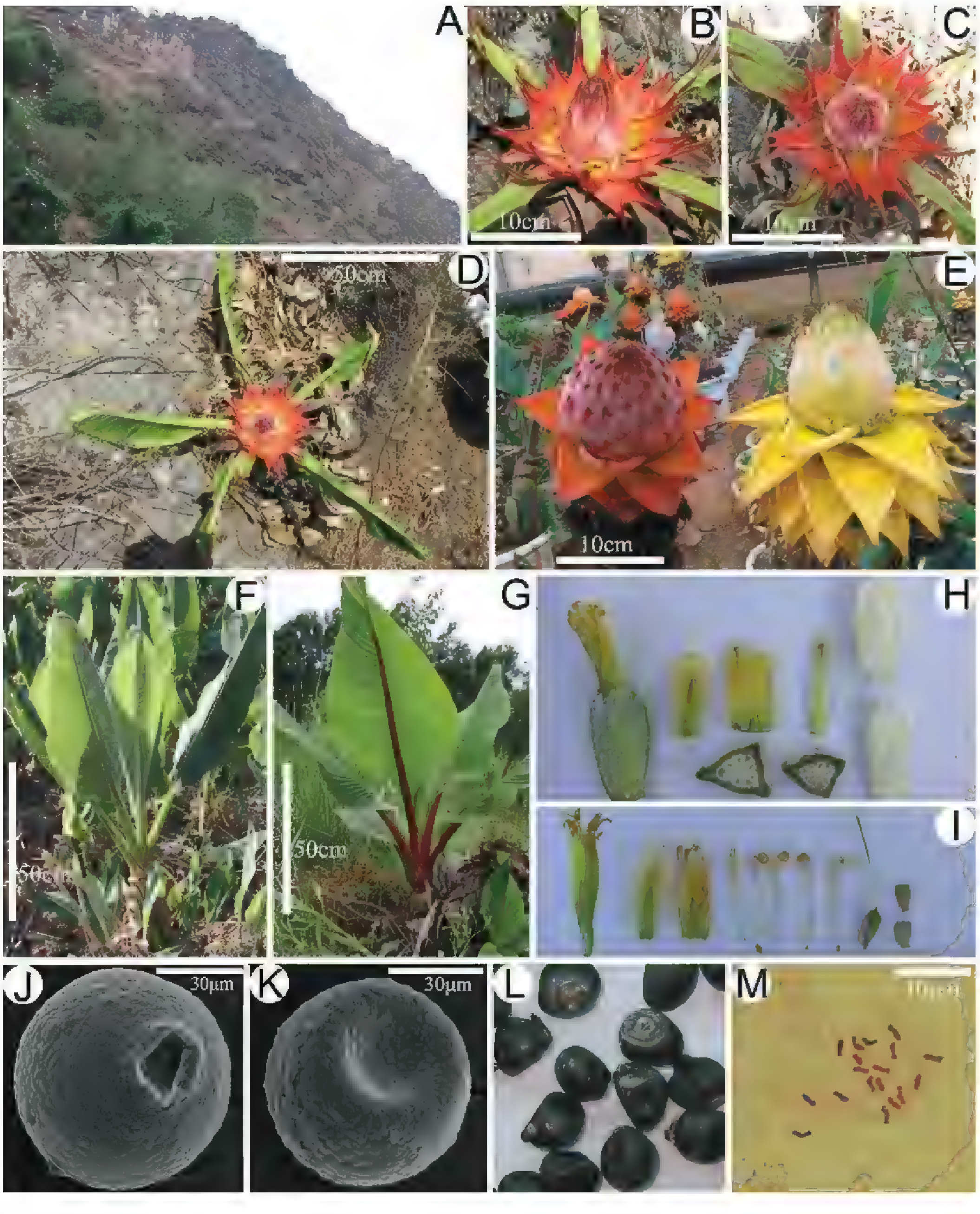

Figure 1. *Musella lasiocarpa* var. *rubribracteata* Zhenghong Li & H. Ma. —A. Habitat. —B, C. Inflorescences in the wild. —D. Plant with inflorescence in the wild. —E. *M. lasiocarpa* var. *lasiocarpa* (right) and *M. lasiocarpa* var. *rubribracteata* (left) cultivated in the greenhouse. —F, G. Leaves of *M. lasiocarpa* var. *lasiocarpa* (F) and *M. lasiocarpa* var. *rubribracteata* (G) showing differences of color of leaf margin, midrib, and petiole. —H. Pistillate flower, showing its components and cross sections of ovaries. —I. Staminate flower, showing its components. —J, K. Scanning electron micrograph showing pollen morphology of single aperture (J) and leptoma (K) in distal pole view. —L. Seeds. —M. Somatic metaphase chromosomes ($2n = 18$). Photo by H. Ma and Q. J. Pan.

variety *lasiocarpa* readily tiller, with more than five tillers observed per individual, rarely three or four; clonal plants could be obtained easily from tillers and unopened young flowers by tissue culture. Fruits number (11 to)19 to 32(to 41) per inflorescence (Ma & Li, pers. obs., from Yunnan and Sichuan provinces, respectively).

Specimens examined. CHINA. **Yunnan:** Near Km marker 71.5 W of Kunming City on Burma Rd., cultivated on dike at edge of paddy fields, ca. 1900 m, 25 July 1984 (fl.), *Sino-American Botanical Expedition to Yunnan Province, China 1311* (KUN 0233084).

1b. Musella lasiocarpa var. **rubribracteata** Zhenghong Li & H. Ma, var. nov. TYPE: China. Sichuan: Panzhihua City, near Upper Yangtze River, 27°05′N, 101°38′E, 1120–1230 m, 15 May 2009 (fr.), *Z. H. Li & H. Ma 09SC66* (holotype, IFRD). Figures 1, 2.

Haec varietas a *Musella lasiocarpa* (Franch.) C. Y. Wu ex H. W. Li var. *lasiocarpa* bracteis aurantiaco-rubris usque rubris, foliorum petiolis abaxialiter et costis utrinque rubellis usque coccineis atque reproductione clonali debiliore differt.

Herbs perennial, tufted; rhizomes horizontal, occasionally sprouting 1 to 4 axillary and basal tillers; pseudostems reddish green, with persistent leaf sheaths, 23–45 × 11–28 cm. Canopy leaves 121–234 cm diam.; leaves expanded proximally into a sheath; blades glabrous, narrowly elliptic, bilaterally symmetric, base subrounded or cuneate, margin entire, reddish green, apex acute or long acuminate, sometimes with spirally thin and long caudate extension, 30–115(–150) × 5–30(–40) cm, abaxial surface often waxy or glaucous, pale green, midrib distinct, light red to purple-red, adaxial surface green to dark green, veins pinnate, distinct along midrib; petiole glaucous, abaxially reddish green to purple-red, 9–47 cm, channeled, margin somewhat membranous, reddish green. Inflorescences indeterminate, terminal, sometimes axillary near base of pseudostem, erect, conical to subglobose, dense, (12–)18–25(–30) cm; bracts (3)5 per whorl, with pistillate flower (with reduced stamens) bracts (3)4 to 7(to 11) in whorls at base and subsequently with staminate flower (with reduced gynoecium) bracts more than 6 whorls above, ovate, zygomorphic, base arciform, margin entire, apex acuminate to caudate, sometimes curving, scarious, persistent, 8.5–18 × 6–10 cm, abaxial surface glaucous, orange-red to red, adaxial surface orange-red to red, sometimes orange near base; flowers arranged in lines with each cluster of flowers subtended by a single bract on an inflorescence; pistillate flowers 3 (occasionally 2 or 4, rarely 1) per bract, tepals 2, usually tubiform, full of nectar, 1.1–1.5 × 0.4–0.8 cm; compound tepals ovate, rectangular to rectangular-orbicular, bilaterally symmetric, margin entire, 5-toothed at apex, 1.5–2.8 × 1.2–2.2 cm, yellowish to yellow, lower part greenish; free tepals ovate-oblong, bilaterally symmetric, membranous, semi-transparent, margin entire, rugulose or wrinkled near apex, emarginated and sometimes shortly cuspidate at apex, 1.4–2.8 × 1.2–2.6 cm, yellowish to yellow, lower part greenish; ovary inferior, broadly ellipsoid or trigonous-ellipsoid, densely hirsute or villous-pilose (with whitish to hyaline trichomes), greenish, 1.9–3.8 × 0.5–2.3 cm diam., locules 3, placentation axile, with 2 lines of ovules; style 1, cylinder trigonous, greenish yellow, 2.1–2.5 × 0.2–0.3 cm; stigma compressed-globose to subglobose, surface concavo-convex, whitish; reduced stamens 5, acuminate, yellow, greenish in lower portion, anther absent, ca. 1.4 × 0.2 cm diam.; staminate flowers (3)4 to 6 per bract, tepals 2, tubiform, full of nectar, 2.1–4.2 × 0.3–0.9 cm, compound tepals 2.3–4.5 × 1–2.2 cm; free tepals 2.3–4.5 × 1.2–2.8 cm; androecium with 5 stamens; filaments subequal, 0.8–2.4 cm; anthers 2-locular, subrectangular, usually reflexed, connective apex emarginate, 1.4–2 × 0.1–0.3 cm, yellow to orange-yellow; reduced gynoecium consisting of the ovary inferior, obovoid, glabrous or sparsely pilose, green, 0.9–1.4 × 0.4–0.6 cm, with ovule absent, style 1, filiform, 2.3–4.7 cm, stigma yellow. Fruit as berries, 3 (occasionally 2 or 4, rarely 1) per bract, (2 to)12 to 22(to 27) per inflorescence, trigonous or tetragonous ovoid or subglobose, densely hirsute, yellowish, green in upper portion, 2.7–5.1 × 2.6–4.8 cm; seeds oblate or irregular, glabrous, black-brown to black, 0.5–1.1 cm diam., 100-seed weight ca. 10 g. Pollen spheroidal, actinomorphic, simple tremoid on distal polar, exine sculpture verrucate, dotted with irregularly ridged tips (Fig. 1J, K). Chromosome number: $2n = 18$.

Distribution and habitat. *Musella lasiocarpa* var. *rubribracteata* is known only from the type locale of Panzhihua City, in southern Sichuan Province, China. The number of mature plants was estimated at fewer than 130 individuals and its geographic range as less than 12 km². The variety was observed to grow on limestone cliffs of a dry, hot valley, 1136–1254 m in elevation. The distance between *M. lasiocarpa* var. *rubribracteata* and the nearest population of its autonymic variety *lasiocarpa* is ca. 10 km. *Nouelia insignis* Franch. (Asteraceae) also occurred at the type locality, with an estimated population of 80 individuals.

IUCN Red List category. We assess the conservation status of this new variety as Critically

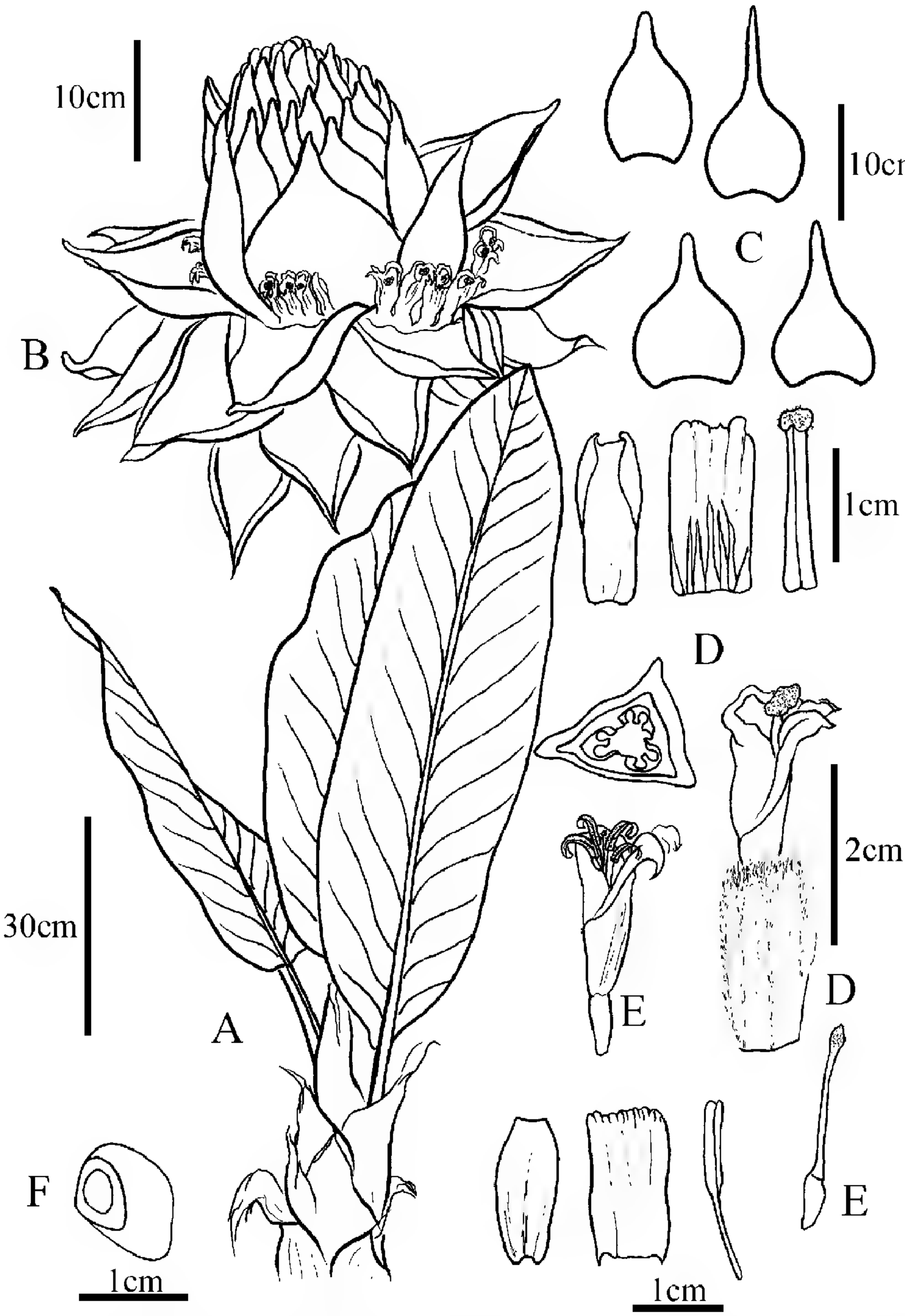

Figure 2. *Musella lasiocarpa* var. *rubribracteata* Zhenghong Li & H. Ma. —A. Plant habit. —B. Inflorescence. —C. Four bracts, showing diversity of shapes. —D. Pistillate flower, showing its component parts and ovary cross section at left. —E. Staminate flower, showing its component parts below. —F. Seed. A–F drawn from the holotype *Z. H. Li & H. Ma 09SC66* (IFRD). Drawing by L. Wang.

Endangered or CR B1ac(iv), according to IUCN Red List criteria (IUCN, 2001), because it is known to exist at only one location and the number of mature plants might fluctuate drastically in the future.

Phenology. The new variety was observed in the greenhouse to flower from February to November, and fruiting was observed throughout the year on different plants. The subsequent anthesis of pistillate flowers on a plant occurred over a ca. 20-day interval, with six days observed for a single flower. For staminate flowers, anthesis for an individual plant ranged from 15 days to several months, with an interval of ca. five days for single flowers (Ma & Pan, pers. obs.).

Cytology. The somatic chromosome number was documented as $2n = 18$, which corresponds to what has been reported for *Musella lasiocarpa* var. *lasiocarpa* (Chen et al., 1991). The chromatids ranged from ca. 2.6–4.3 μm long (Fig. 1M). Because the chromosome number does not vary between the two taxa, recognition of the novelty is restricted to the varietal rank rather than species.

Taxonomic relationship. *Musella lasiocarpa* var. *rubribracteata* distinctly differs from the autonymic variety by its orange-red to red bracts that are sometimes orange near the bract bases. A reddish green to purple-red coloration is seen on the abaxial petioles, and the leaf midrib can be light red to purple-red on the abaxial surface and occasionally on the adaxial surface, in contrast to the green lamina. *Musella lasiocarpa* var. *rubribracteata* demonstrates a lesser tendency to clonally reproduce, with only one to four tillers observed per plant. Propagation was difficult from tillers and unopened young flowers by tissue culture resulting from severe browning. Bracts of plants developing from tillers of *M. lasiocarpa* var. *rubribracteata* were also orange-red to red in color. Plants of variety *rubribracteata* tend to produce fewer fruits on average, with (2 to)10 to 22(to 27) per inflorescence.

Paratype. CHINA. **Sichuan:** Panzhihua City, near Upper Yangtze River, 27°05′N, 101°38′E, 1120–1230 m, 1 May 2011 (fl.), *Z. H. Li & H. Ma 2011SC009* (KUN).

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A New Combination in the Fern Genus *Osmundastrum* (Osmundaceae)

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Abstract. From eastern North America, the glandular pubescent variety of *Osmunda cinnamomea* L. var. *glandulosa* Waters (Osmundaceae) is transferred as *Osmundastrum cinnamomeum* (L.) C. Presl var. *glandulosum* (Waters) McAvoy.

Key words: IUCN Red List, North America, *Osmunda*, Osmundaceae, *Osmundastrum*.

In studying the phylogenetic relationships among the infragenera in Osmundaceae, Metzgar et al. (2008) and Jud et al. (2008) confirmed the work of earlier studies (Tagawa, 1941; Hewitson, 1962; Bobrov, 1967; Miller, 1967, 1971; Yatabe et al., 1999, 2005) that the genus *Osmunda* L. is paraphyletic and that the taxon traditionally treated as *Osmunda cinnamomea* L. is sister to the rest of the family. The authors support the recognition of *Osmundastrum* C. Presl at the level of genus and recognize *Osmundastrum cinnamomeum* (L.) C. Presl as its only extant species.

In 1902, Campbell Easter Waters (1872–1955) described a variety of *Osmunda cinnamomea* distinguished by its densely glandular pubescent foliage as *O. cinnamomea* var. *glandulosa* Waters. Since this time, phylogenetic investigation and taxonomic placements assign the species to *Osmundastrum*, but Waters's variety has never been transferred. This oversight is corrected herein, in recognition of the distinctiveness of the taxon. The varietal name is further lectotypified.

Osmundastrum cinnamomeum (L.) C. Presl var. **glandulosum** (Waters) McAvoy, comb. nov. Basionym: *Osmunda cinnamomea* L. var. *glandulosa* Waters, Fern Bull. 10: 21–22. 1902. TYPE: U.S.A. Maryland: Glen Burnie, low wet woods with the typical, 17 July 1901, *C. E. Waters s.n.* (lectotype, designated here, PH-079887).

Discussion. Specimens of the glandular variety were stated to be at the "National Museum, Gray Herbarium" (Waters, 1902: 22), and syntypes were confirmed and designated at both institutions. The specimen at PH designated here as the lectotype was annotated by Waters as "type specimen."

Osmunda cinnamomea var. *glandulosa* has been variously treated by different authors. Fernald (1942, 1950) recognized this variety, as did Reed (1953) and Montgomery and Fairbrothers (1992). Others treat it invalidly as a form (Broun, 1938; Weakley, 2010), while others simply include the variety under synonymy (Whetstone & Atkinson, 1993), or do not consider it (Gleason & Cronquist, 1991). Wagner (1991: 20) was intrigued with this taxon and stated: "there is a remarkable plant known as *O. cinnamomea* var. *glandulosa*, named by the noted Maryland fern expert C. E. Waters at the turn of the century, that appears not only to merit recognition, but may even constitute a distinct microspecies." When Fernald (1942: 353) first encountered this species in Virginia, he noted that: "whenever we took hold of the abundant *Osmunda cinnamomea*, it stuck to our fingers. Search for ordinary *O. cinnamomea* failed to reveal it. The whole sphagnous wood was given over to the somewhat local var. *glandulosa*."

Waters (1902: 21) recognized that both the glandular-pubescent variety and the typical variety of the species occurred together under the same ecological conditions and that both maintained their distinctiveness: "Both the variety and the typical form of the species grow in large numbers in low sphagnum woods.... It cannot be said that the variation is due to peculiarities of soil or to varying amounts of sunlight, for the two forms grow side by side all through the woods." I have also observed both the glandular and nonglandular varieties growing together in populations in Delaware, Maryland, and New Jersey, and both varieties maintain their uniqueness in such settings.

Figure 1 illustrates the distinctiveness between *Osmundastrum cinnamomeum* var. *glandulosum* and *O. cinnamomeum* var. *cinnamomeum*. The underside of the leaf and the margins of variety *glandulosum* are covered with stiff, glandular hairs (< 1 mm long) that are regularly scattered throughout the lamina and on the midrib. The glandular hairs on the upper side of the leaf are sparse and tend to be confined to the veins. The rachis and petioles are also densely

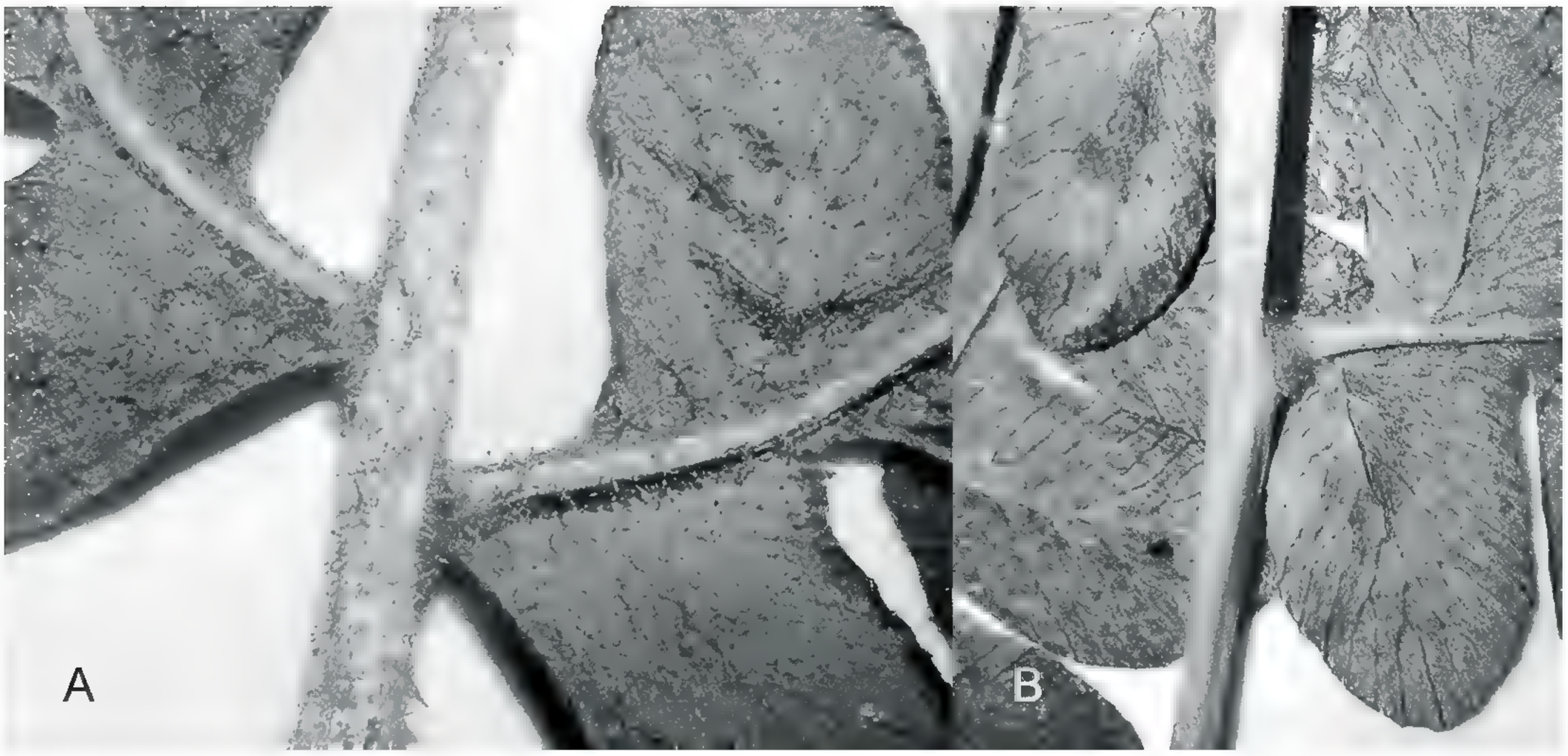

Figure 1. Comparison of *Osmundastrum cinnamomeum* var. *glandulosum* (A), with *O. cinnamomeum* var. *cinnamomeum* (B).

covered with glandular hairs, where they intermingle with the long, curly hairs typical of the species. The variety *cinnamomeum*, of course, lacks the glandular hairs just described.

Based on collection records (DOV, GH, NCU, PH, and US) and the literature (Fernald, 1942, 1950; Reed, 1953; Wagner, 1991; Montgomery & Fairbrothers, 1992; McAvoy, 2007; Virginia Botanical Associates, 2010), *Osmundastrum cinnamomeum* var. *glandulosum* appears to occur most frequently on the Atlantic coastal plain, where it forms rather large colonies in swampy woods and floodplains. Specimens of *O. cinnamomeum* var. *glandulosum* exist from the following states: New Jersey, Delaware, Maryland (supported by the type), Virginia, North Carolina, South Carolina, Georgia, and Alabama. *Osmundastrum cinnamomeum* var. *glandulosum* is reported in the literature from Mississippi (Fernald, 1950; Reed, 1953), Rhode Island (Fernald, 1950), and West Virginia (Wagner, 1991).

IUCN Red List category. The conservation status of *Osmundastrum cinnamomeum* var. *glandulosum* has not been evaluated against IUCN Red List criteria (IUCN, 2001); therefore, an assessment of Not Evaluated (NE) has been assigned.

Paratypes. U.S.A. **Alabama:** Baldwin Co., Perdido River, 2008, *W. Barger & B. Holt s.n.* (Anniston Mus. Nat. Hist., AUA, TROY, UNA). **Delaware:** Sussex Co., Concord, 2010, *W. McAvoy 6580* (DOV). **Georgia:** Colquitt Co., 1966, *W. Faircloth s.n.* (NCU). **New Jersey:** Burlington Co., Buddtown, 2010, *W. McAvoy & W. Knapp 6577* (DOV). **North Carolina:** Martin Co., Conoho Creek, 1958, *E. Radford et al. s.n.* (NCU). **South Carolina:** Richland Co., Ft. Jackson, 1993, *A. Pitman & A. McBee s.n.* (NCU). **Virginia:** Fairfax Co., Potomac Bluffs, 1899, *W. Palmer 280* (US).

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The Identity of *Synandropus* and a New Combination in Neotropical Menispermaceae

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Abstract. *Synandropus membranaceus* A. C. Sm. (Menispermaceae), known previously only from the type collection, is lectotypified and *Synandropus* A. C. Sm. is reduced to synonymy of *Odontocarya* Miers, within section *Somphoxylon* (Eichler) Barneby. The new combination *O. membranacea* (A. C. Sm.) R. Ortiz is made; *O. uva-alba* Barneby and *O. arifolia* Barneby are reduced to synonymy under *O. membranacea*.

Resumen. Se lectotipifica *Synandropus membranaceus* A. C. Sm. (Menispermaceae), conocida anteriormente sólo de la colección tipo y se reduce *Synandropus* A. C. Sm. a sinónimo de *Odontocarya* Miers, en la sección *Somphoxylon* (Eichler) Barneby. Se hace la nueva combinación de *O. membranacea* (A. C. Sm.) R. Ortiz; *O. uva-alba* Barneby y *O. arifolia* Barneby son considerados como sinónimos de *O. membranacea*.

Key words: Menispermaceae, Neotropics, *Odontocarya*, sect. *Somphoxylon*, *Synandropus*.

The monotypic genus *Synandropus* A. C. Sm. (Menispermaceae) was described from Pará, Brazil. In the protologue, Smith (1931) compared *Synandropus* to *Odontocarya* Miers and *Somphoxylon* Eichler. *Synandropus* was distinguished from *Odontocarya* by its three stamens (vs. six stamens in *Odontocarya*) and its partially fused filaments (vs. fully connate in *Somphoxylon*). Its three petals (vs. six petals) distinguished *Synandropus* from both *Odontocarya* and *Somphoxylon*. Subsequently, Barneby (1970) reduced *Somphoxylon* to a section within *Odontocarya*, but *Synandropus* was maintained.

Among Neotropical Menispermaceae, *Odontocarya* sect. *Somphoxylon* (Eichler) Barneby is distinguished by its racemose, cauliflorous staminate inflorescence with three orders of branching and a 3-merous synandrium. Herein, *Synandropus* is reduced to synonymy of *Odontocarya*, specifically to synonymy of *Odontocarya* sect. *Somphoxylon*. Among the 12 species of *Odontocarya* sect. *Somphoxylon*, the combination of a glabrous inflorescence axis, six sepals, six fleshy petals, and a 3-merous synandrium is found only in *O. arifolia* Barneby, which in the protologue was reported to occur in Peru and Brazil (Barneby, 1970).

Odontocarya sect. **Somphoxylon** (Eichler) Barneby, Mem. New York Bot. Gard. 20(2): 110. 1970. Basionym: *Somphoxylon* Eichler, Flora 47: 396. 1864. TYPE: *Somphoxylon wullschlaegelii* Eichler [= *Odontocarya wullschlaegelii* (Eichler) Barneby].

Synandropus A. C. Sm., Bull. Torrey Bot. Club 58: 93. 1931, syn. nov. TYPE: *Synandropus membranaceus* A. C. Sm. [= *Odontocarya membranacea* (A. C. Sm.) R. Ortiz].

Odontocarya membranacea (A. C. Sm.) R. Ortiz, comb. nov. Basionym: *Synandropus membranaceus* A. C. Sm., Bull. Torrey Bot. Club 58: 93. 1931. TYPE: Brazil. Pará: Breves, Amazon estuary, swampy jungle, 23 Oct. 1929 (♂ inflor.), *E. P. Killip & A. C. Smith 30217* (lectotype, designated here, NY 00320662 [♂ inflor., leafless branch at left]; duplicate, US 0010973 [♂ inflor., leafless branch at left]). Figure 1.

Odontocarya arifolia Barneby, Mem. New York Bot. Gard. 20(2): 120. 1970, syn. nov. TYPE: Peru. Loreto: Aguaytía, in forest, 250 m, 20 May 1959 (fr.), *F. Woytkowski 5374* (holotype, F 1532620; isotype, MO 1744787).

Odontocarya uva-alba Barneby, Mem. New York Bot. Gard. 22(4): 142. 1972, syn. nov. TYPE: Peru. San Martín: in forest thicket, Saposoa, 14 Oct. 1959 (fr.), *F. Woytkowski 5519* (lectotype, designated here, MO 3459413 [fruiting branch]; duplicates, MO 2143393 [fruiting branch, leaves excluded], NY not seen). Figure 2.

Discussion. The type of *Synandropus membranaceus* A. C. Sm. is a mixed collection comprising material from two plant families. The leafless staminate inflorescence on the left of the NY lectotype (Fig. 1A) correctly belongs to the Menispermaceae, but the remaining leafy stems (Fig. 1B) are clearly allied to the Euphorbiaceae. The

Figure 1. Lectotype of *Synandropus membranaceus* A. C. Sm., *E. P. Killip & A. C. Smith 30217* NY 00320662 (♂ inflor., leafless branch at left). —A. Staminate inflorescence of *Odontocarya membranacea* (Menispermaceae). —B. Leafy branch of *Tragia* (Euphorbiaceae).

membranous serrate leaves and paired stipules are characteristic for the genus *Tragia* L. The 3-merous synandrium of *Synandropus* is a character shared with *Somphoxylon*; the latter has been recognized as a section within *Odontocarya* (Barneby, 1970). Further, the lectotype of *Synandropus membranaceus* corresponds with the protologue of *O. arifolia*, differing only in having three petals. However,

Figure 2. Lectotype of *Odontocarya uva-alba* Barneby, *Woytkowski 5519* [fruiting branch] MO 3459413.

variation in the number of petals (from three to six) is occasionally observed in the widespread *O. arifolia*; hence, the two names are considered synonymous, and *Synandropus membranaceus* is transferred to *Odontocarya*.

Another name here considered is *Odontocarya uva-alba* Barneby, described from Peru. The taxon was distinguished by Barneby (1972) from the Amazonian *O. arifolia* by the indument on the abaxial leaf surface as well as by its inter-Andean

geographical distribution. Barneby (1972: 143) designated two sheets (then in LA, since transferred to MO) as the holotype, a third sheet consisting of a fragment, likely of a leaf, and drupe at NY was listed as the isotype. Yet a fourth sheet, MO 2143393, also labeled as an isotype and verified by Barneby, was not listed in the protologue. The part of the holotype, originally labeled as "sheet 2," albeit subsequently called "sheet #1" on Barneby's annotation label, consists solely of fruiting material, and the one originally labeled as "sheet 1" has leaves only. The 2-order branching of the fruiting specimen (Fig. 2) corresponds well with *O. membranacea*. However, the leafy shoot on the sterile sheet of Barneby's holotype and that of the duplicate, MO 2143393, are identified here as *Aristolochia fragrantissima* Ruiz (Aristolochiaceae), and this material is excluded. Thus, the fruiting element of *F. Woytkowski 5519* is here selected as the lectotype, and the name *O. uva-alba* is treated as a synonym of *O. membranacea*.

New species described from representatives of a single sex in a dioecious family such as the Menispermaceae compound the problem of associating further collections to the type specimen. For instance, although staminate features were described for *Odontocarya arifolia*, Barneby (1970) cited a fruiting specimen as the holotype.

I examined additional staminate collections subsequently determined as *Odontocarya arifolia* and found that these specimens have either a 1-merous or a 3-merous androecium, while the petals vary not only in numbers, as either three or five, but also they vary substantially in the degree of fusion, ranging from free to partially connate or completely connate and forming a tube. Included in my expanded concept of *O. membranacea* in the staminate condition are specimens distinguished by a 3-merous synandrium only, while specimens having a 1-merous androecium are referred to *O. monandra* Barneby, a species known from Loreto, the locality of the type, as well as from the departments of Ucayali and San Martín in Peru.

In the pistillate condition, although initially features of leaves and endocarps were examined, specimens were assigned to *Odontocarya membranacea* based on features of the endocarp as well as geographic proximity to locations where staminate individuals have been collected. Features of the endocarp surface on the type of *O. uva-alba* resemble those of *O. membranacea*, in agreement with Barneby (1970), who compared the endocarp of *O. uva-alba* to those of *O. arifolia*, as encompassed by the current taxonomic concept of *O. membranacea*.

As recognized here, *Odontocarya membranacea* is characterized as a medium-sized subwoody climber found in lowland forests across Bolivia, Brazil, Ecuador, and Peru, at elevations ranging from 130 to 500 m. Distribution in Ecuador is based on reports by Ott (1997). Leaves are ovate, 12.5–19 × 7–13 cm, the base is cordate to truncate, the sinus shallow or deep, 0.9–5 cm deep. Staminate inflorescences have three orders of branching and are glabrous; staminate flowers have six sepals, three, five, or six fleshy petals, and three stamens that are partially to fully connate; flowers were collected from August through November. Pistillate inflorescences and pistillate flowers were not observed; infructescences have two orders of branching, fruits were found in March, May, and from July through November. These fruits are oblongoid, 1.1–1.3 × 0.7–0.9 cm; the endocarp is scarcely ornamented with discontinuous, sinuose low ridges on the abaxial surface that do not form a reticulate pattern, and have an oblongoid adaxial opening ca. (3–)5 × 1 mm that corresponds with the adaxial intrusion (the condyle). The endocarp ornamentation of the type of *O. uva-alba* is similar to that of *O. membranacea*, although the adaxial opening is shorter than in most typical *O. membranacea* (ca. 3 × 1 mm). The character, however, displays ample variation across the range of the species.

Additional specimens examined. BOLIVIA. **La Paz:** Franz Tamayo, Madidi, Chalalan, sendero Paraba, (fr.), *A. Araujo-M. et al. 1153* (MO); Parque Nac. Madidi, río Hondo, (♂ fl.), *A. Fuentes 4326* (MO). ECUADOR. Cited by Ott (1997), but not verified herein. PERU. **Loreto:** Maynas, Rio Yavarí, Puerto Amelia, cerca a Atalaya Pueblo Brasilero, (♂ fl.), *J. Revilla 2153* (MO). **Madre de Dios:** flooded forest near Cocha Cashu Station on an old ox-bow lake of the Rio Manu, (♂ fl.), *R. B. Foster 2556* (F), *5919* (F), *7224* (F); vic. Cocha Cashu, Parque Nac., (imm. fr.), *R. B. Foster & J. Terborgh 6464* (F); Tambopata, alrededores del albergue turístico Cusco Amazónico, Río Madre de Dios, ca. 35 km de Puerto Maldonado, (fr.), *P. Núñez et al. 9958* (MO); primary floodplain plot 5, along Rio La Torre Trail, Explorer's Inn, near confluence of Rio Tambopata and Rio La Torre, 39 km SW of Puerto Maldonado, (♂ buds), *S. F. Smith 276* (US).

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A New Species of *Hechtia* (Bromeliaceae) from Chihuahua, Mexico

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ABSTRACT. *Hechtia edulis* I. Ramírez, Espejo & López-Ferr. (Bromeliaceae) is described and illustrated from Copper Canyon National Park, Chihuahua, Mexico. The new entity is characterized by its caespitose, monocarpic habit, by its small rosettes, and by the similarity of its staminate and pistillate inflorescences in size, the simple panicles with the branching much shortened, the flowers sessile, the floral bracts scarious, and pistillate flowers with petals green and carnose.

RESUMEN. Se describe e ilustra *Hechtia edulis* I. Ramírez, Espejo & López-Ferr. (Bromeliaceae) del Parque Nacional Barranca del Cobre, Chihuahua, México. Esta nueva entidad se caracteriza por su hábito cespitoso, rosetas monocárpicas, de tamaño pequeño y por la similitud de sus inflorescencias estaminadas y pistiladas, panículas simples con ramas muy cortas, flores sésiles, brácteas florales escariosas y flores pistiladas con pétalos verdes y carnosos.

Key words: Bromeliaceae, Chihuahua, *Hechtia*, IUCN Red List, Mexico.

The genus *Hechtia* Klotszch (Bromeliaceae) comprises ca. 60 species distributed from southern Texas (U.S.A.) to northern Nicaragua. Approximately 56 species are endemic to Mexico, and only four species range outside this country. Thus, this is the one genus within the Bromeliaceae with the most endemism in Mexico (ca. 94%; Espejo-Serna et al., 2004). All the described species are dioecious, with the exception of *H. gayorum* L. W. Lenz, which is a polygamomonoecious species from Baja California. Plants of *Hechtia* are terrestrial, growing mostly as lithophytes on calcareous, volcanic, or chalky soils.

Understanding the species limits in *Hechtia* has been difficult because most of the species are known only from one sex and more commonly from fruiting specimens, probably because the flowering intervals are usually extremely short, less than two weeks. Moreover, sexual dimorphism is very common among species in the genus, with the inflorescence size and ranking, as well as the flower texture and color, quite variable between staminate and pistillate individuals of the same species. Several species, such as *H. stenopetala* Klotzsch and *H. schottii* Baker, show larger inflorescences, with more numerous and fragrant flowers on staminate specimens when compared with pistillate ones that tend to present more pauciflorous, shorter inflorescence with flowers that are odorless. In only a few instances are the dioecious taxa similar in measurements for staminate and pistillate inflorescences (i.e., *H. rosea* E. Morren ex Baker). The new species described herein is remarkable for this similarity.

Hechtia has traditionally been considered within the bromelid subfamily Pitcairnioideae, although recent phylogenetic analyses based on molecular markers have challenged this hypothesis. While several phylogenetic analyses support the monophyly of the genus (Duvall et al., 1993; Horres et al., 2000; Reinert et al., 2003; Givnish et al., 2004), the broader relationships of *Hechtia* with other genera within the family are uncertain (Givnish et al., 2007). In analyses, *Hechtia* has appeared in a basal position (Reinert et al., 2003), outside the Pitcairnioideae s. str., as the sister group of Tillandsioideae (Horres et al., 2000; Crayn et al., 2004). More recently, the genus has been supported as its own subfamily, as the Hechtioideae (Givnish et al., 2007). Internal relationships within the genus have not been approached in any of the published phylogenetic analyses to date, and there is far from a satisfactory understanding of its relationships.

A monograph of the entire genus *Hechtia* is ongoing, and as a result extensive fieldwork has been carried out for several years to clarify species numbers and limits. Preliminary studies suggest a suite of informative characters to delimit taxa within

the genus, using vegetative as well as floral features. These include monocarpic (with terminal inflorescence) versus polycarpic (with lateral inflorescences) rosettes, sessile versus pedicellate flowers, caespitose versus rhizomatous growth, glabrous versus tomentose surfaces, and spinose versus serrulate leaves, among other morphological aspects. As a result, eight species have been recently described from complete herbarium material (staminate, pistillate, and fruiting specimens). These recent novelties include *H. perotensis* I. Ramírez & Mart.-Correa and *H. nuusaviorum* Espejo & López-Ferr. (Espejo-Serna et al., 2007), *H. pretiosa* Espejo & López-Ferr. and *H. zamudioi* Espejo, López-Ferr. & I. Ramírez (Espejo-Serna et al., 2008), *H. lepidophylla* I. Ramírez (Ramírez, 2008), *H. caulescens* López-Ferr., Espejo & Mart.-Correa (López-Ferrari et al., 2009), and *H. chichinautzensis* Mart.-Correa, Espejo & López-Ferr. and *H. colossa* Mart.-Correa, Espejo & López-Ferr. (Martínez et al., 2010). As a continuation of these studies, we propose here an additional new species from the state of Chihuahua in northern Mexico.

Hechtia edulis I. Ramírez, Espejo & López-Ferr., sp. nov. TYPE: Mexico. Chihuahua: Mpio. de Batopilas, 13 km antes de llegar a Batopilas, viniendo de La Bufa, 27°06′28″N, 107°40′18″W, 695 m, talud en selva baja caducifolia, florecida en cultivo en junio 2007, *I. Ramírez & G. Carnevali 1527* (holotype, CICY [♀]; isotypes, MO [♀], UAMIZ [♀]). Figures 1, 2.

Haec species a congeneris habitu caespitoso monocarpico, foliorum rosulis parvis, inflorescentiis staminatis pistillatisque magnitudine colore formaque similibus, paniculis semel ramificantibus ramis brevissimis, bracteis floralibus scariosis, floribus sessilibus atque florum pistillatorum petalis viridibus carnosis distinguitur.

Herbs dioecious, monocarpic, rupicolous, with caespitose, globular, small rosettes, ca. 25–40 cm diam., inflorescence emerging from the center of a fully developed rosette, new rosettes forming at the axils of the leaves or usually at the scape bases, thus the inflorescence appears lateral, but it is actually central. Leaves forming a mounded rosette; foliar sheaths ca. 1.2 × 2 cm, oblong, margins dentate, thin, white lepidote on both surfaces; foliar blades succulent, narrowly triangular, 14–20 × 0.9–1.2 cm, glabrous and shiny adaxially, white lepidote abaxially, apex acute, pungent, becoming revolute on external blades, erect on internal blades, margins strongly serrate, spines 1.5–2 mm, 5–6 mm apart, antrorse, retrorse, or forming a 90° angle with the foliar margin. Inflorescences a terminal, erect, once-branched panicle in both sexes, up to 4× longer than rosette height, to 60–70 cm. Staminate inflorescences with an erect peduncle, 90–100 cm, terete in cross section, 3–4 mm diam., glabrous; scape bracts similar to leaves in shape, texture, and spines, 6.5–8 × 0.9–1 cm, much longer than internodes; internodes 2.5–3.5 cm; peduncle bracts narrowly triangular, acute to long acuminate, 3–6(–9) × 0.8–1 cm, slightly shorter or longer than internodes, densely white lepidote on both surfaces, margins serrate; rachis slightly sinuose, the internodes 1.5–5 cm, decreasing in length toward the apex, branches 11 to 17 per inflorescence, ascending at an acute angle with the rachis, the upper branches forming a 90° angle, (1–)3–7 cm, without sterile portion, (2 to)15 to 20 flowers per inflorescence branch; primary bracts much shorter than these secondary axes, decreasing in size acropetally, but generally 1/4 the length of the branch, ample, widely triangular, acute and long acuminate, 15–20 × 7–8 mm, apex pungent, strongly nervate when dry, margins serrate, drying light brown (color on fresh material not known). Flowers ca. 11 × 3 mm (diam.), sessile; floral bract oblong in general shape, asymmetric, apex acute, 3–3.5 × 3.8–4 mm, margins irregularly serrate, thin, generally 3-nerved, color when fresh unknown, drying light brown, cucullate; corolla open, campanulate; sepals basally connate to petals by ca. 1 mm, ovate, obtuse, 3–3.5 × 2.2–2.3 mm, 3-nerved, apex slightly dentate, margins sinuose, erose; petals widely elliptic, obtuse, apically cucullate, 4.5–5 × 3.4–3.5 mm, margins irregular, 7- to 9-nervate, very thin in texture, 3 of the stamens adnate to the petals and the other 3 free, filaments ca. 3.8 mm, 1-nervate, wider at the base, anthers basifixed, ca. 1 mm, base hastate; pistillode ovoid, ca. 3 × 1.5 mm (diam.), stigmatic lobes reduced, shorter than 0.5 mm. Pistillate inflorescences 51–80 cm high, much longer than rosette height; scape bracts narrowly triangular, long acuminate, apex pungent, 7.5–8(–13) × 0.4–0.6 cm, margins strongly serrate, spines antrorse or retrorse, abaxial surface densely white lepidote, scarcely white lepidote adaxially, with tuft of hairs on spines and along the margins; peduncle erect, terete in cross section, (7–)9–10(–17) cm × 4–5 mm (diam.), internodes 2–2.5(–3.5) cm; peduncle bracts narrowly triangular, acute and short acuminate, apex pungent, adnate to the scape, 2–4(–6.5) × 0.5–0.7 cm, margins serrate, white lepidote on both surfaces, shorter, equaling or longer than internode length; rachis slightly sinuose, 44–90 cm × 3–4 mm (diam. at base), decreasing to 1 mm at the apex, smooth, green, drying light brown; internodes 1.5–4 cm, becoming shorter acropetally; branches ascending,

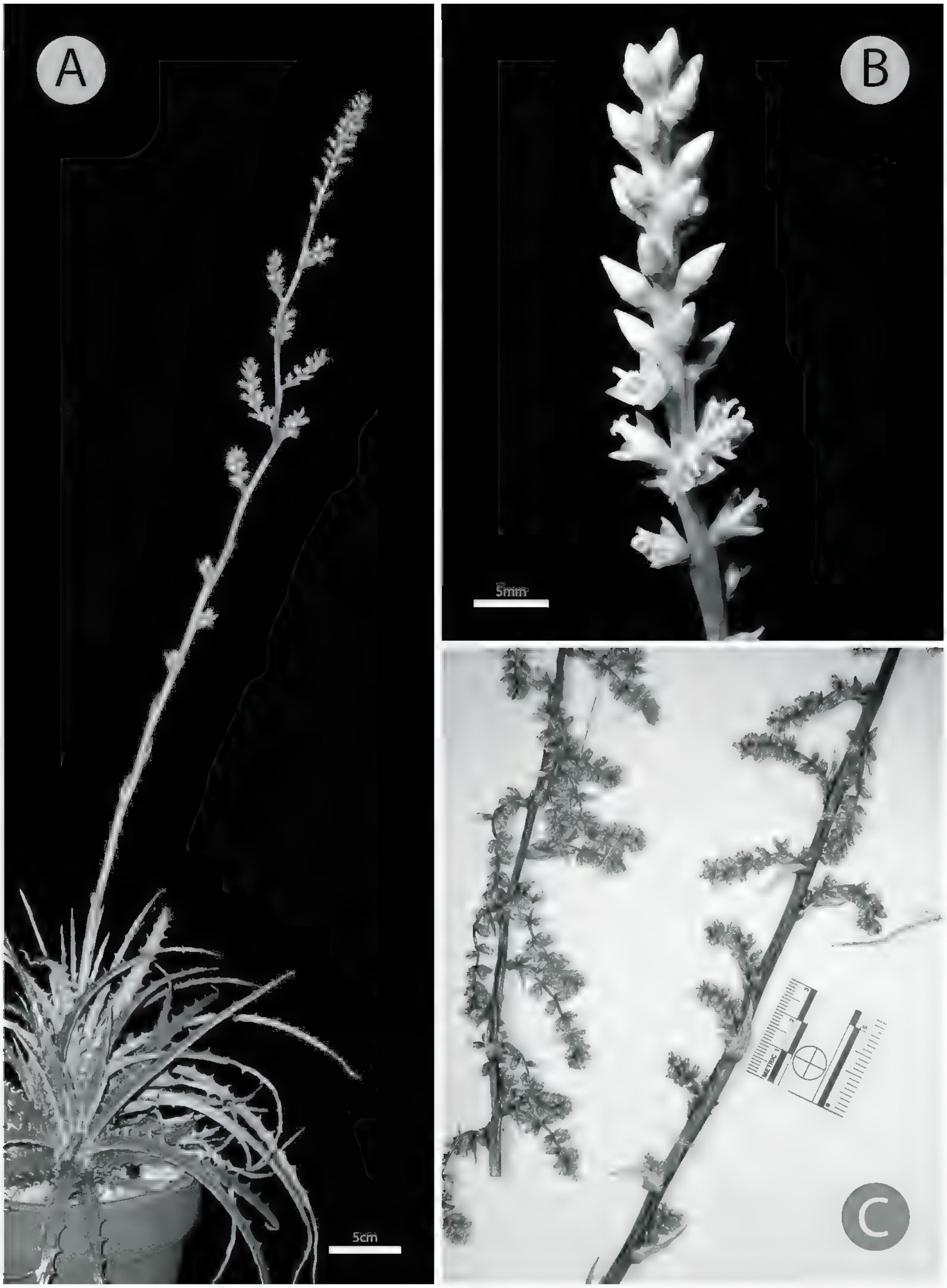

Figure 1. *Hechtia edulis* I. Ramírez, Espejo & López-Ferr. —A. Pistillate plant in bloom. —B. Pistillate branch. —C. Staminate branches. A, B from the holotype *I. Ramírez & G. Carnevali 1527* (CICY); C from the paratype *R. Bye 8855* (TEX). Photographs by Ivón M. Ramírez M.

forming an acute angle with the inflorescence rachis, branches (2–)4–6 cm, dense, 10 to 16 branches per inflorescence, 10 to 18 flowers per branch, some branches toward the inflorescence apex reduced to one flower; primary bracts variable in shape and size, triangular, asymmetric, acute and long acuminate, 1–1.5 × 0.5–0.8 cm, much longer than the sterile portion of the branch, margins sinuose, finely and

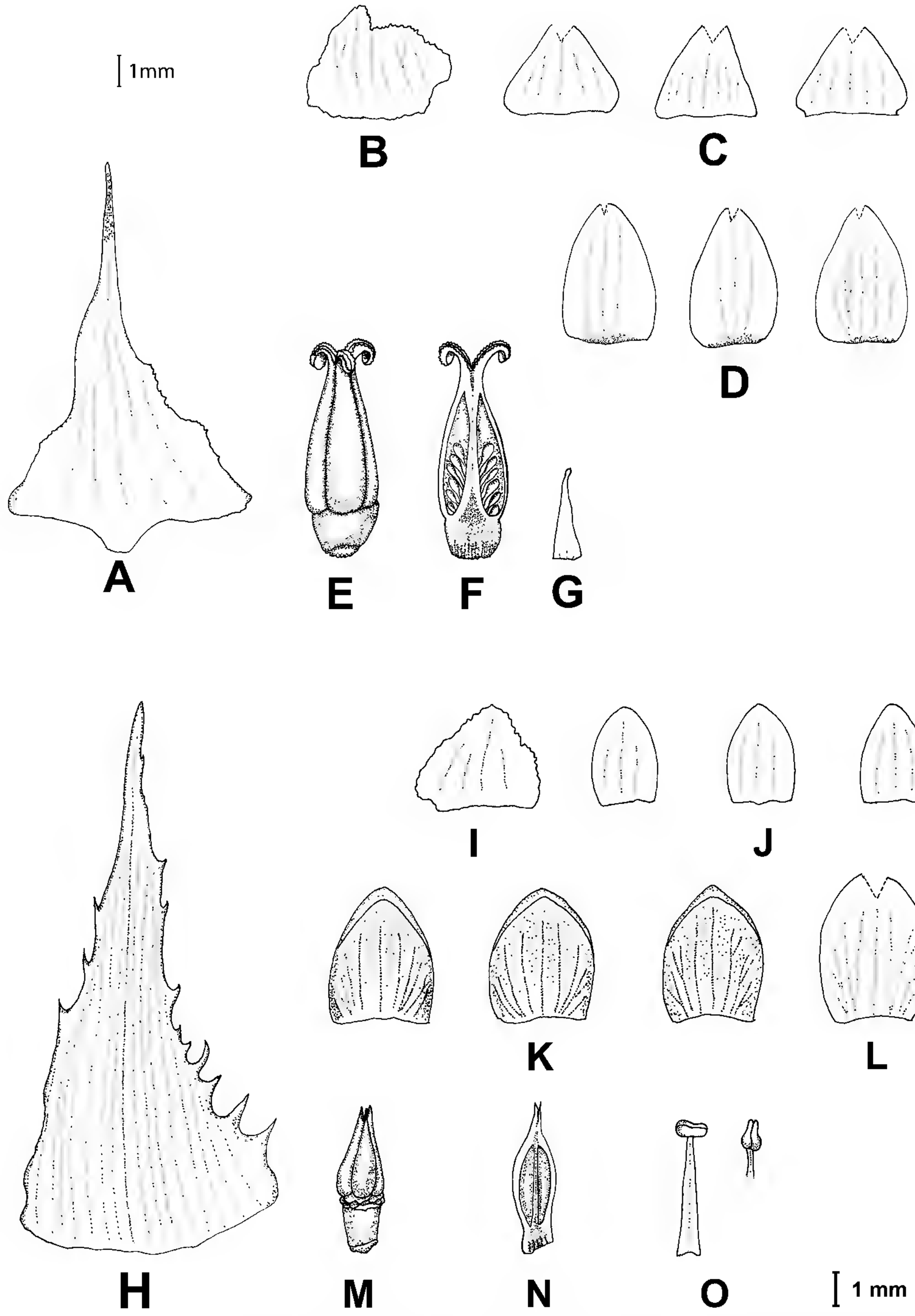

Figure 2. *Hechtia edulis* I. Ramírez, Espejo & López-Ferr. A–G. Floral dissection, pistillate structures. —A. Primary bract. —B. Floral bract. —C. Sepals. —D. Petals. —E. Ovary. —F. Longitudinal section of the ovary. —G. Staminode. H–O. Floral dissection, staminate structures. —H. Primary bract. —I. Floral bract. —J. Sepals. —K. Petals. —L. Petal with apical portion flattened. —M. Pistillode. —N. Longitudinal section of pistillode. —O. Androecium, with detail of anther apex at right. A–G based on the paratype, *I. Ramírez et al. 1326* (CICY); H–O based on the paratype *R. Bye 8855* (TEX).

irregularly erose at base, conspicuously 5-nerved, apex finely lepidote, brown and dry when flowers in anthesis, drying light brown. Flowers ca. 5 × 3 mm (diam.), almost sessile, peduncle conic, thick, ca. 1–1.5 mm, green; floral bracts rectangular in overall shape, but variable among flowers in the same branch and inflorescence, asymmetric, margins irregular, somewhat erose, apical portion unequal, the longest portion 3–3.5 mm long, the shortest ca. 2.5 × 2.8 mm, nerves variable in number and position, sometimes a central one with 2 lateral ones, these bifurcating, sometimes 3 nerves on one side of the central nerve; sepals free, widely triangular, margins slightly erose, 2–2.5 × 3–3.2 mm, obtuse, fleshy, green basally, apically light brown and dry in anthesis, adnate to petals during anthesis, nerves variable in number, 5 to 7, sometimes lateral nerves bifurcating apically; petals free, widely elliptic to ovate, 4–4.5 × 2.8–3 mm, apex acute, concave, green, fleshy, 3- to 5-nerved, sometimes 1 or 2 lateral nerves bifurcating, variable; staminodes narrowly triangular, elongated, 2.5–3 mm, acute, very thin, white; ovary superior, ovoid, 4–5 × ca. 2.3 mm (diam.), green, the placentation central, ovules orthotropous, white, 0.5–0.7 mm; stigmatic lobes ca. 1 mm, revolute, margins glandular, yellowish. Capsules ovoid, 7–10 × 2–3 mm (diam.), dark brown, sepals, petals, and stigmatic lobes persistent; seeds not seen.

Distribution and habitat. *Hechtia edulis* has been collected in Copper Canyon National Park, in Barranca de Batopilas and Barranca de Candameña, two of 20 canyons that are located in southwestern Chihuahua State in the Sierra Madre Occidental. There are ca. 40 bromeliaceous records for 10 out of 67 municipalities in the state of Chihuahua (Espejo-Serna et al., 2004), indicating a lack of information on plant diversity of this unexplored and inaccessible state. There are only two genera of the Bromeliaceae (*Pitcairnia* L'Hér. and *Tillandsia* L.), with one and eight species, respectively, reported for the area; *H. edulis* is the first record of the genus for the state. Individuals of this species grow as lithophytes on exposed, sheer cliffs in low caducifolious forest and oak-pine forest, forming small colonies of one to four rosettes.

IUCN Red List category. *Hechtia edulis* is only known from three localities from the same area. Much of the area is still unexplored, and therefore it is possible that larger populations exist. The species is subject to anthropogenic pressure (leaves are eaten raw by the native Tarahumara people in the region); however, based on this inadequate information, we assess its conservation status as Data Deficient (DD), according to IUCN Red List criteria (IUCN, 2008).

Phenology and reproductive biology. We first became aware of the existence of this species during our study of Robert Bye's collections (*4474* and *8855*) during a stay at the Missouri Botanical Garden in the summer of 2004. Both vouchers featured staminate plants. A year later, a collecting trip was planned to obtain complete material of both sexes in Barranca de Batopilas during September 2005. We were successful in finding the populations; the plants, however, only carried old, open fruits. We collected a few rosettes and were eventually able to flower pistillate plants under cultivation and prepared the specimens cited here. This species blooms from June to August and fruits immediately after, with the fruits dehiscing seeds until the next year, probably more so during the beginning of the rainy season. Fruiting percentage appears to be 100%, as in many other species in the genus, with pollination most likely by bees based on color and shape of the corolla.

Etymology. The specific epithet refers to the fact that the leaves of *Hechtia edulis* are eaten by the Tarahumara people (fide *Bye 8855*).

Discussion. *Hechtia edulis* is peculiar among species in the genus because its staminate and pistillate inflorescences and flowers are extremely similar in size and shape, an unusual feature in this genus where staminate and pistillate inflorescences and flowers may greatly differ. As for many taxa in the genus, the affinities of the new species are unknown. Among other features, the size and shape of the rosettes place it in a group of species displaying small rosettes such as *H. marnier-lapostollei* L. B. Sm. and *H. lyman-smithii* Burt-Utley & Utley. This last taxon also presents similarities between inflorescence structures and dimensions among sexes, although these are variable within the population (Burt-Utley & Utley, 1987).

The new species is monocarpic, which distinguishes it from the polycarpic species in the genus that tend to grow and form large colonies of large rosettes. The pistillate inflorescence takes a long time to develop (approximately a month, pers. obs.), but all flowers reach anthesis over a two- or three-day interval. The pistillate inflorescence is short for the genus, only to 80 cm, and the flowers resemble those of *Hechtia stenopetala* and *H. perotensis*, species also featuring sessile flowers, dry scarious floral bracts and sepals (even in anthesal flowers), whitish or greenish, short, succulent petals, and a comparatively large ovary with thick stigma lobes. Nevertheless, *H. edulis* differs from both of these species by its smaller

rosettes, with leaves only to 20 cm long, when compared with the larger rosettes, with leaves ca. 50–100 cm long, of *H. stenopetala* from Veracruz and *H. perotensis* from Puebla and Veracruz in Mexico.

Ethnobotany. Robert Bye collected staminate plants in 1973 and 1978 and mentioned that the "crisp leaves eaten raw all year around" and "spines removed from succulent leaves and leaves eaten" by the Tarahumara people, one of the most important ethnic groups in the Sierra Madre Occidental that extend across the states of Chihuahua, southwestern Durango, and Sonora. The Tarahumaran name for the plant is "chikana," and it is considered a member of the class "me" or "meke" (the agave) (fide R. Bye, in sched.).

Paratypes. MEXICO. **Chihuahua:** Mpio. de Batopilas, along La Bufa Quirare rd. on N side of Barranca de Batopilas, 5500 ft., 26 Aug. 1978, *R. A. Bye 8855* (CM [♂], TEX [♂]); S of Quirare, on N side of Barranca de Batopilas, 5000–6000 ft., oak forest in open area, 2 Aug. 1973, *R. A. Bye 4474* (ECON [♂]); 13 km antes de llegar a Batopilas, viniendo de La Bufa, 27°06′28″N, 107°40′18″W, 695 m, 8 Sep. 2005, *I. Ramírez, A. Espejo, A. R. López-Ferrari, A. Mendoza R. & J. Ceja 1326* (CICY [fr.]), *A. Espejo, A. R. López-Ferrari, J. Ceja, A. Mendoza R. & I. Ramírez M. 6836* (UAMIZ [fr.]); same locality, flowering in cultivation in Mérida, Yucatán, 1 June 2009, *I. Ramírez & G. Carnevali 1618* (IEB [♀], K [♀], MEXU [♀], NMC [♀], NY [♀], SEL [♀], TEX [♀], W [♀], XAL [♀]); Mpio. Ocampo, Parque Nacional Cascada de Basaseachic, 28°311″N, 108°12′30″W, 1570 m, in the barranca at the base of the falls, on rock at the base of dry S-facing cliffs, rather dry pine and oak woods, 4 Oct. 1986, *R. Spellenberg, R. Soreng, R. Corral & T. Lebgue 8832* (MEXU [fr.], NMC).

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A New Awned Species of *Paspalum* (Poaceae, Panicoideae, Paniceae) from Brazil

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Abstract. A new species of *Paspalum* L. (Poaceae, Panicoideae, Paniceae), *P. rostratum* D. Ramos, Valls & R. C. Oliveira, from the Distrito Federal in central Brazil, is described and illustrated. The new species is awned and is related to *P. biaristatum* Filg. & Davidse and *P. longiaristatum* Davidse & Filg., to which it is compared. Distinguishing features of *P. rostratum* include shorter awns and a rostrate upper lemma, as well as the free branching and flowering from the upper nodes, with the successive branches forming cymose branching systems.

Resumo. Uma nova espécie de *Paspalum* L. (Poaceae, Panicoideae, Paniceae), *P. rostratum* D. Ramos, Valls & R. C. Oliveira, do Distrito Federal, Brasil, é descrita e ilustrada. Essa nova espécie é aristada e é relacionada a *P. biaristatum* Filg. & Davidse e *P. longiaristatum* Davidse & Filg. e a elas é comparada. As características que distinguem *P. rostratum* incluem aristas mais curtas e lema superior rostrado, além dos colmos muito ramificados nos nós superiores, formando um sistema de ramificação cimoso.

Key words: Brazil, IUCN Red List, Paniceae, Panicoideae, *Paspalum*, Poaceae.

During a study on the phenology of grass species in the Distrito Federal, Brazil, an unusual 2-awned *Paspalum* L. (Poaceae) species was collected.

Other 2-awned *Paspalum* species include *P. biaristatum* Filg. & Davidse and *P. longiaristatum* Davidse & Filg., both from areas of serpentine soils in central Brazil. These awned species were accommodated within *Paspalum* sect. *Biaristata* Filg. & Davidse, within subgenus *Ceresia* (Pers.) Rchb. (Filgueiras & Davidse, 1994). More recently, Denham et al. (2002) merged *Paspalum* sect. *Biaristata* with section *Ceresia* (Pers.) Nees (1829), so as to render section *Ceresia* monophyletic, with this latter name having priority.

Samples for leaf anatomy were sectioned from the middle portion of the blade. Culm sections were from the second or third stem internode from the top. Roots were sectioned at 3 cm from the shoot. Cross sections were made with a Ranvier microtome, clarified and stained with Alcian blue and safranin 1%, and mounted using a synthetic resin (Paiva et al., 2006). Photomicrographs were made using the Olympus CX31 optical microscope with an Olympus C-7070 digital camera (Olympus Corp., Shinjuku-ku, Tokyo, Japan).

Paspalum rostratum D. Ramos, Valls & R. C. Oliveira, sp. nov. TYPE: Brazil. Distrito Federal: Sobradinho, Reserva Ecol. Perm. do Centro Nac. de Pesquisa do Cerrado (Embrapa CPAC), 15°39′33.57″S, 47°43′29.46″W, 1100 m.s.m., área com declividade de 45°, ecótono campo sujo—mata de galeria, 20 Apr. 2009, *D. M. Ramos & P. D. Alves 16* (holotype, UB; isotypes, BAA, CEN, MO). Figures 1, 2.

Species *Paspalo longiaristato* Davidse & Filg. et *P. biaristato* Filg. & Davidse prae gluma superiore aristata et lemmate inferiore aristato similis, sed a hoc racemo uno, aristis brevioris et lemmate superiore apice rostrato ab omnibus congeneris culmis in nodis superioribus profuse ramosis differt.

Caespitose perennial; base of tillers forming very short, curved rhizomes with numerous cataphylls; culms 60–82 cm tall, ca. 2 mm diam., erect, freely branching and flowering from nodes in the upper 1/3; successive branches arising from the axils of the upper leaf sheaths and forming cymose branching systems; internodes and nodes glabrous. Leaf sheaths longer than the internodes, glabrous, the dead ones remaining and bladeless, obscuring culm bases, with evident auricles; ligules ca. 0.3 mm, membranous, rounded to obtuse, erose, hyaline, with dorsal trichomes ca. 1.5 mm, erose; blades 2.5–8.5 × 0.05–0.1(–0.2) cm, linear-lanceolate or lanceolate,

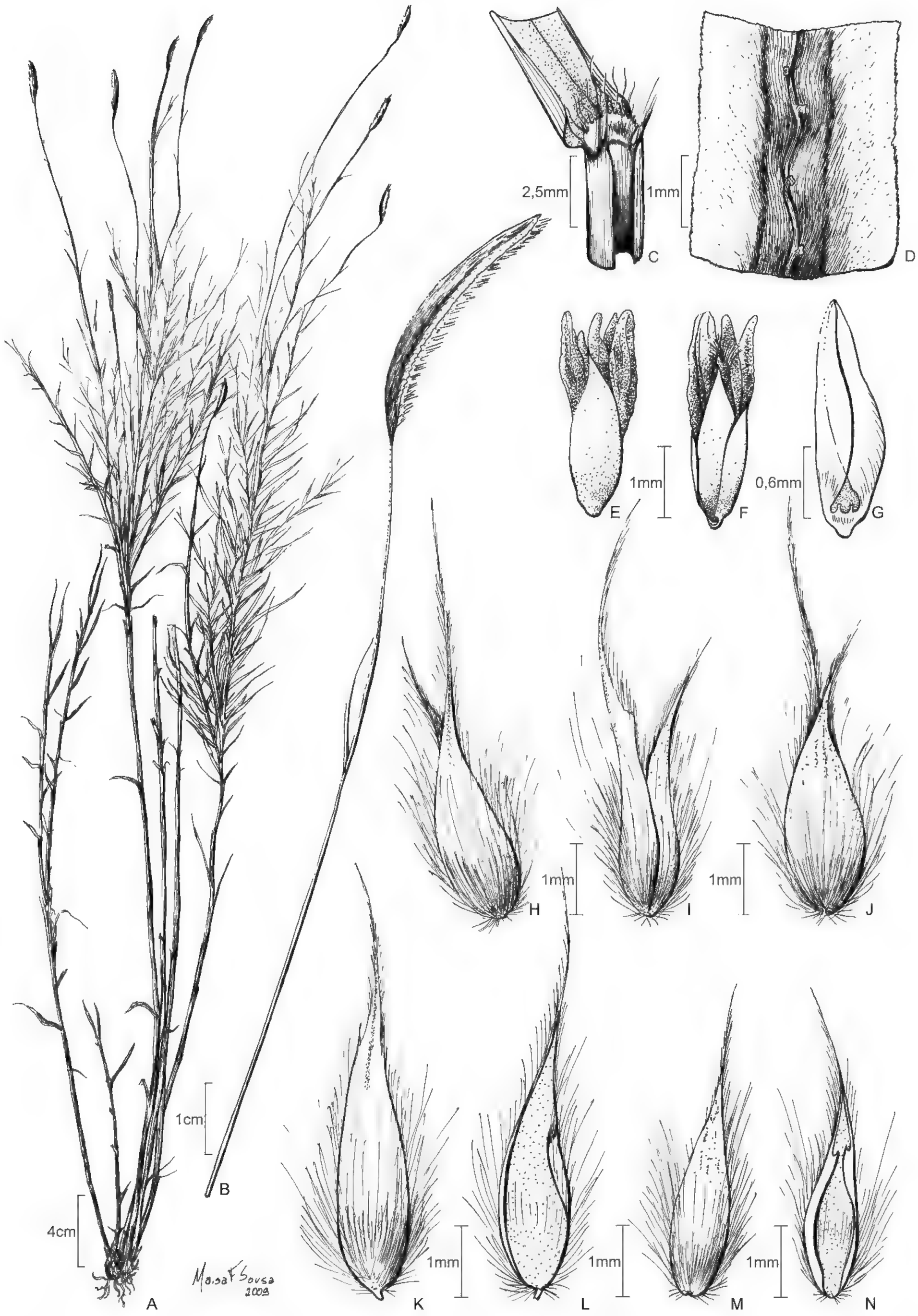
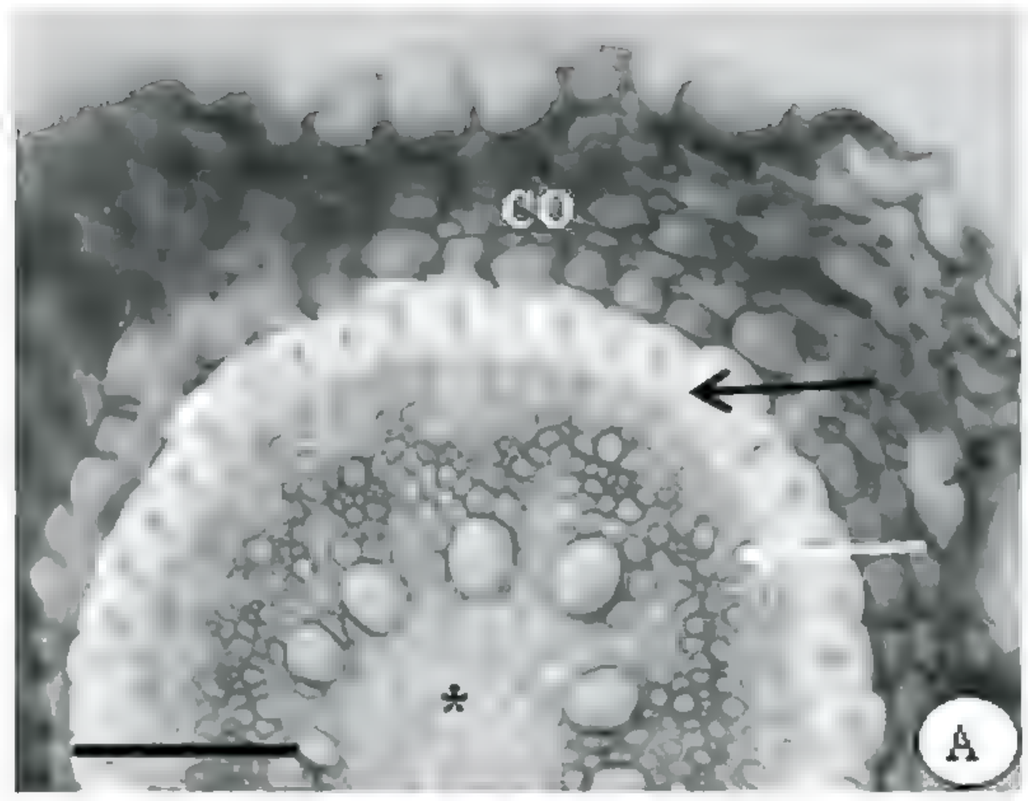
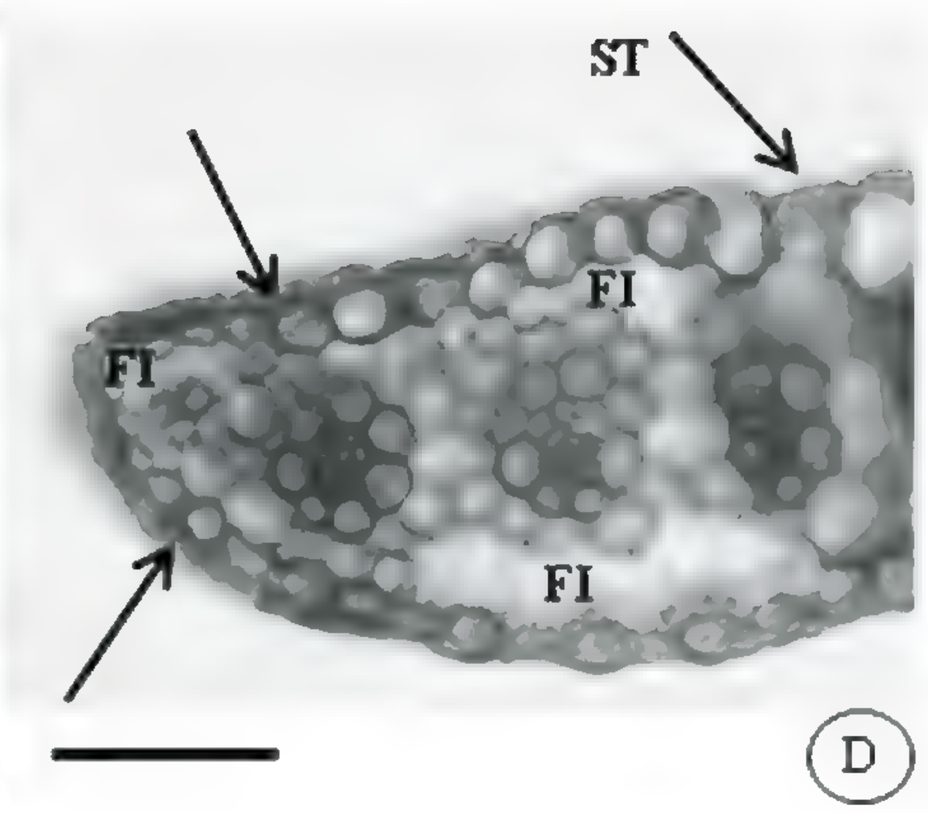
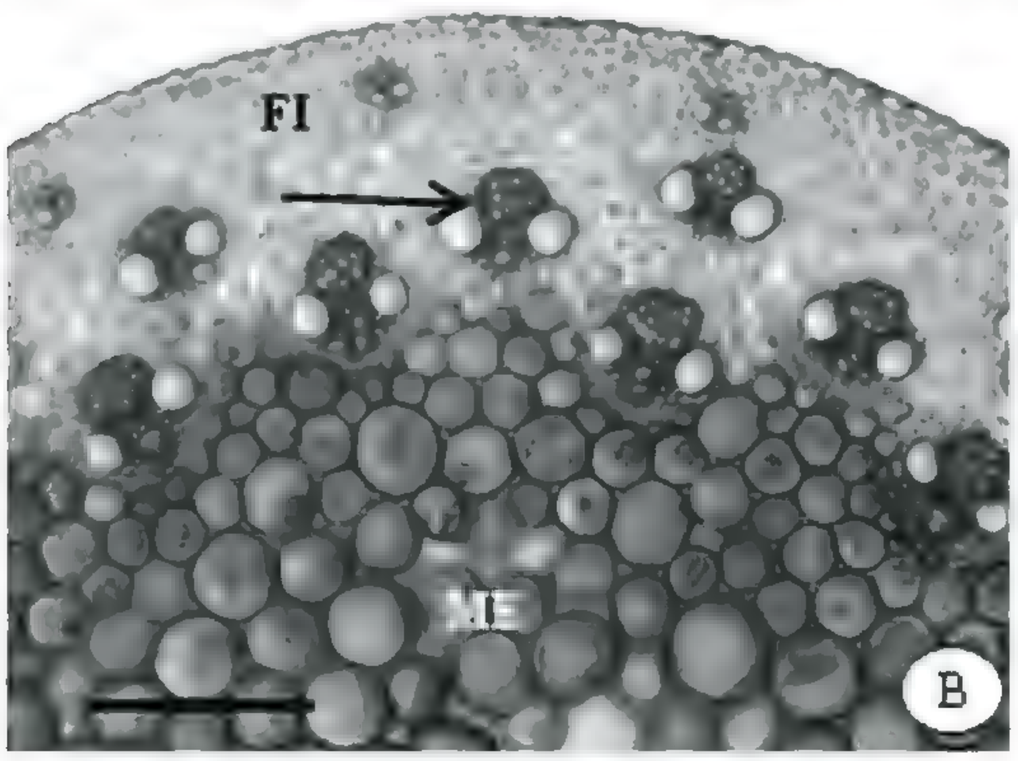
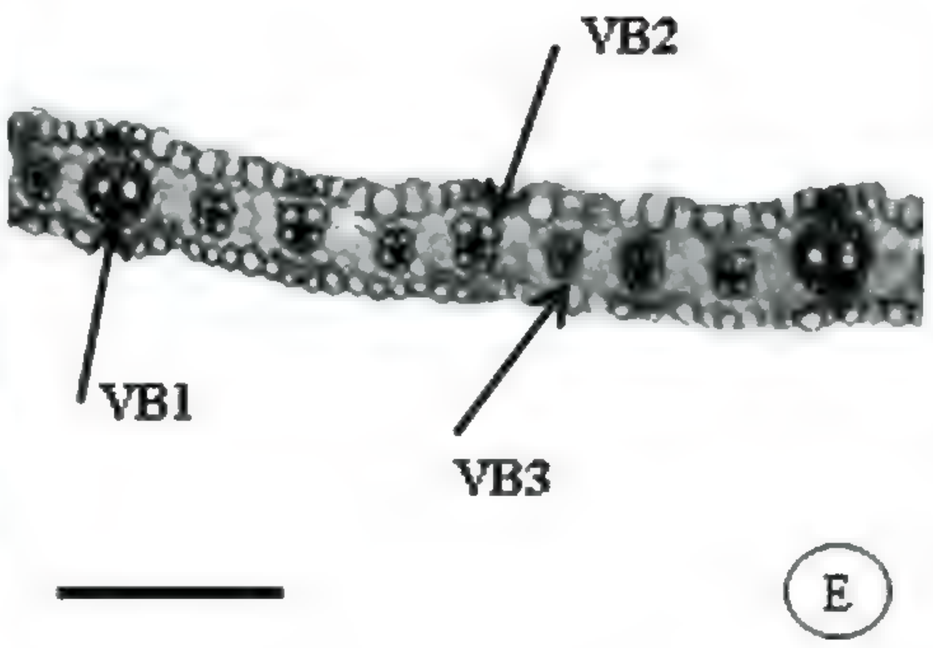


Figure 1. *Paspalum rostratum* D. Ramos, Valls & R. C. Oliveira, based on the holotype *Ramos & Alves 16* (UB). —A. Habit. —B. Detail of flowering culm. —C. Ligular region with auricles. —D. Segment of winged rachis, with the pedicels. —E. Upper anthecium, dorsal view. —F. Upper anthecium, ventral view. —G. Upper palea, ventral view, with the gynoecium evident. —H. Spikelet, dorsal view, showing upper glume. —I. Spikelet, lateral view, with detail of the lateral extension of the upper glume. —J. Spikelet, ventral view, showing lower lemma. —K. Upper glume, dorsal view. —L. Upper glume, ventral view, detail of asymmetric lateral extension. —M. Lower lemma, dorsal view. —N. Lower lemma, ventral view, with detail of symmetric lateral extensions.









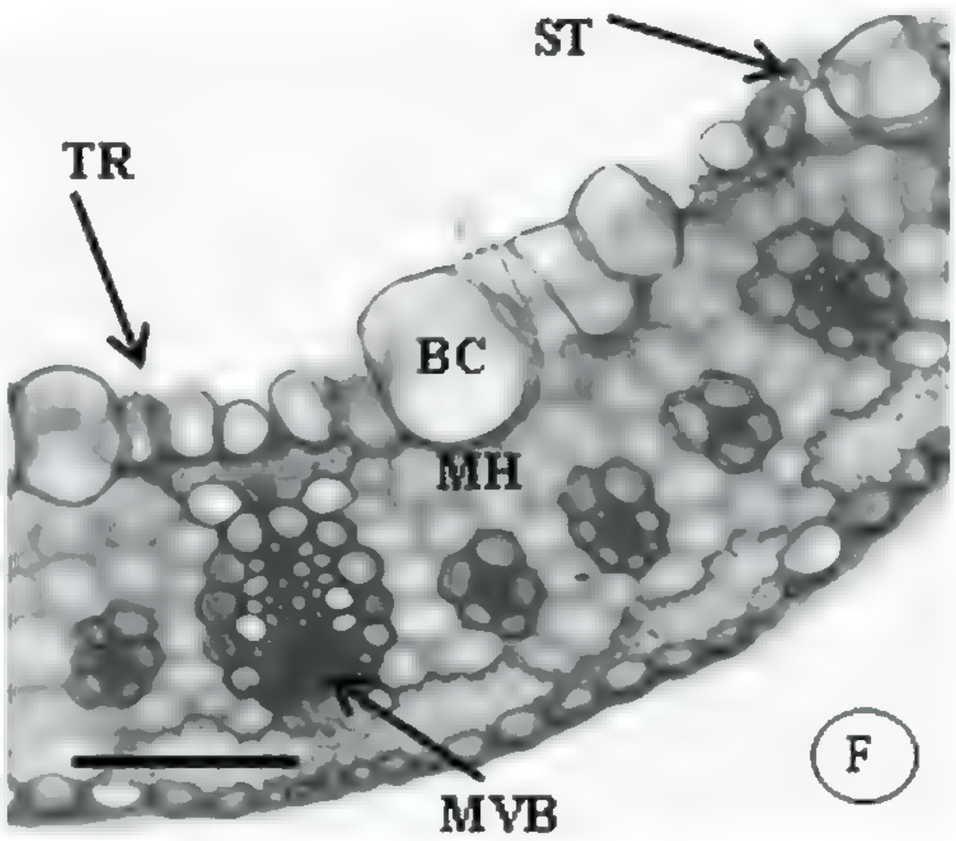


Figure 2. *Paspalum rostratum* D. Ramos, Valls & R. C. Oliveira, taken from *Oliveira & Ramos 2482* (UB). —A. General view of the root section: short cortical region (CO), endodermis (black arrow), pericycle (white arrow), and densely thickened medulla (*). —B. General view of the culm section: lignified epidermis, cortical region with fibers (FI), vascular bundles (black arrow), and parenchymatic medulla (ME). —C. General view of the leaf blade section. —D. Detail of leaf margin: thickened cuticle (black arrows), stomata (ST), and fibers (FI) in the mesophyll. —E. Detail of mesophyll: vascular bundles (VB1, VB2, VB3) and one to two parenchyma cells between bundles (white *). —F. Detail of median bundles: first-order vascular bundle with single-layered sheath (MVB) and homogeneous mesophyll (MH), bulliform cells (BC), trichome (TR), and stomata (ST) in the adaxial face. Scale bars: A, B, E — 200 μm; C — 500 μm; D, F — 50 μm.

patent, flat to folded (when dry) and apparently subulate, glabrous on both surfaces but hirsute adaxially when young; blade base slightly broader than the sheath, apex acuminate, margins finely scabrous; lower blades deciduous. Peduncles 3–9 cm, terete, glabrous; inflorescences mostly exserted; racemes single, ascending, 1.5–4 cm; raceme rachis 3–4 mm wide, glabrous, greenish to purplish at the

middle, conspicuously winged (wings hyaline), with longitudinal veins at the wings, ending in a naked point; pedicels minute, glabrous. Spikelets solitary, 3–3.2 × 0.8–1 mm, biseriate, compactly imbricate, dorsiventrally compressed; lower glume absent; upper glume 3–3.2 × 0.8–1 mm, membranous, densely silky-pilose at the base (trichomes ca. 2 mm) and minutely pilose on the distal margins, glabrous elsewhere, with 1 asymmetric lateral extension, 3-nerved, lateral nerves submarginal; apex attenuate with an awn 1–1.8 mm. Lower lemma ca. 2.8 × 1 mm, membranous, with symmetric lateral extensions, 3-nerved; apex attenuate to an awn 0.8–1.4 mm; indument as in the upper glume; upper anthecium 2–2.1 × 0.5–0.6 mm, membranous, narrowly ellipsoid, dorsiventrally compressed, whitish, deciduous at maturity; lemma with rostrum and minute apical trichomes; palea rostrate, glabrous; lodicules minute; stamens 3, anthers ca. 2 mm, orange. Caryopsis 0.9–1.1 × 0.5–0.7 mm, oblong, hilum elliptical.

The above measurements were taken from fertile, intensively branched herbarium specimens. Experimentally cultivated, well-irrigated plants produced thicker younger stems, up to 2.95 mm diam. Young basal blades on not-yet-proliferated culms on cultivated plants averaged 7–15 cm in length, eventually reaching 16.5 cm long and 0.5–0.75 cm wide.

Distribution and habitat. The species has been found in savanna-forest ecotones, at the edge of gallery forests, and is known so far only in Distrito Federal, Brazil. Plants of *Paspalum rostratum* persist in the natural vegetation, totally dry and erect, throughout the dry season.

IUCN Red List category. So far, *Paspalum rostratum* is only known from two sites 36.6 km apart, both in legally conserved areas. Although the documented occurrence is restricted and no further searching has yet been conducted, there is no evidence of population decline or of a possible threat of extinction. Because insufficient information is available, we assess *P. rostratum* as Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001).

Etymology. The epithet of the new species refers to the rostrate lemma and palea of the upper anthecium.

Anatomy. Root (Fig. 2A) epidermal cells are large, presenting thin walls. The exodermis is uniseriate, slightly thickened, followed by up to four layers of parenchyma cells. In the endodermis, cells are squared, large, densely lignified, with reduced lumen. The pericycle is unistratified and lignified; the phloem is external to the xylem, which is disposed in an interrupted cylinder; the metaxylem is in five or more arches; and the medullar cells are lignified. The culm (Fig. 2B) epidermis is densely sclerified. The cortical region is composed only of irregularly sized fibers and has a reduced lumen. In this region, small leaf traces are immersed. First-order vascular bundles are distributed in two arches and surrounded by fibers; medullar cells are parenchymatic, rounded, with thin walls, and large intercellular spaces. Leaf blades are U-shaped in cross section, with the midrib not developed (Fig. 2C); the adaxial epidermis (Fig. 2D) has papillose epidermal cells, fan-shaped or rounded bulliform cells, protuberant stomata, silicified cells, cushion macrohairs, prickle hairs, and bicellular microhairs; the abaxial epidermis has a thick cuticle and papillose cells, silicified cells, level stomata, and microhairs; the mesophyll is homogeneous, consisting of radial parenchyma cells around the vascular bundles; three orders of vascular bundles are present (Fig. 2E), all with a single-layered sheath; first-order vascular bundles have an adaxial sclerenchyma cap; the abaxial surface has two or three layers of small-diameter sclerenchyma adjacent to the stomata; the adaxial surface has only one discontinuous layer of sclerenchyma, close to the second-order vascular bundles, these separated by one or two parenchyma cells (Fig. 2F).

Discussion. Plants of *Paspalum rostratum* are distinguished from its congeners by the free branching and flowering from the upper nodes and the successive branches arising from the axils of the leaf sheaths, forming cymose branching systems. The dead sheaths remain, although without blades, and obscure the culm bases.

In Denham et al. (2002), *Paspalum* subg. *Ceresia* was supported by the characters of the membranous upper anthecium and the upper palea gaping at the apex, based on exomorphological characters. In other most-parsimonious trees based on the same characters, the lower lemma with pilose margins and the upper lemma with unicellular macrohairs also support this clade. According to these criteria, the new species taxonomically assigns within subgenus *Ceresia*. Within this subgenus, Denham et al. (2002) recognized two sections, section *Ceresia* and section *Pectinata* Chase ex Rodr.-Rodr. *Paspalum rostratum* is related to those species assigned to section *Ceresia*, which includes 18 other species, based on the following synapomorphies: the upper glume with pilose margins, the upper glume pilose on the lower half, and the margins of the upper glume folded along the marginal nerves. Two subgroups were found in this clade by Denham et al. (2002) as clades A and B.

In all most-parsimonious trees, *P. longiaristatum* and *P. biaristatum*, both species that have an awned upper glume and lower lemma, constitute a well-supported terminal group in clade A (also with *P. goyasense* Davidse, Morrone & Zuloaga, *P. carinatum* Humb. & Bonpl. ex Flüggé, *P. eucomum* Nees ex Trin., *P. malmeanum* Ekman, *P. ceresia* (Kuntze) Chase, and *P. stellatum* Humb. & Bonpl. ex Flüggé). Two equally parsimonious topologies were found in clade A: the first where *P. stellatum* is the sister species of *P. longiaristatum* and *P. biaristatum*, supported by the presence of marginal nerves on the lower lemma lacking marginal extension. In the second resolution, *P. ceresia* was sister to *P. longiaristatum* and *P. biaristatum*, due to the absence of lodicules. Almost all the characters above are homoplasic, because *P. rostratum* has the lower lemma without marginal nerves and with extension of the margins, and lodicules are present, which is therefore inconsistent with the topologies of Denham's trees.

The leaf blade anatomy of *Paspalum rostratum* is typical for the Panicoideae: bicellular microhairs, fan-shaped bulliform cells, radial parenchyma around the vascular bundles, Kranz anatomy subtype MS (XyMS-; Hattersley & Watson, 1976), and two cells between vascular bundles. Other blade characters are typical in *Paspalum*: the presence of stomata and papillae on both epidermal surfaces as well as cushion macrohairs. The culm is peculiar to the species, with a densely sclerified epidermis and the cortical region consisting only of fibers, an aspect not mentioned in the literature for other species. Sclerification was also observed for cells of the root endodermis and medulla.

Key to Two-awned *Paspalum* Species from West-Central Brazil

1a. Annual plants dwarf, only to 40 cm tall; spikelets 1.8–2.2 mm long . . . *P. longiaristatum*
1b. Perennial plants > 60 cm tall; spikelets 3–4.5 mm long.
2a. Inflorescence with a single raceme; spikelets 3–3.2 mm long; awn ca. 1–1.8 mm long; anthecium rostrate . . . *P. rostratum*
2b. Inflorescence with (1)2 to 4(to 7) racemes; spikelets 3.8–4.5 mm long; awn 4–7.1 mm long; anthecium acute . . . *P. biaristatum*

Paratypes. BRAZIL. **Distrito Federal:** Sobradinho, Reserva Ecol. Perm. do Centro Nac. de Pesquisa do Cerrado (Embrapa/CPAC), 15°39′33.57″S, 47°43′29.46″W, 1100 m.s.m., 20 Apr. 2009, *J. E. Q. Faria Júnior 488* (K, RB, UB); 15°39′33.57″S, 47°43′29.46″W, 27 July 2009, *R. C. Oliveira & D. M. Ramos 2482* (UB); Lago Oeste, APA da Cafuringa, Poço Azul, 15°34′54.42″S, 48°02′50.22″W, 11 Sep. 2009, *D. M. Ramos & R. C. Oliveira 42* (UB).

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A New Combination in *Spiraea* (Rosaceae) from Ulleung Island, Korea

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ABSTRACT. A rare endemic species on Ulleung Island, Korea, is transferred from *Physocarpus* (Cambess.) Raf. (Rosaceae) to *Spiraea* L., based on morphology and DNA sequence data. The new combination *S. insularis* (Nakai) H. Shin, Y. D. Kim & S. H. Oh is proposed.

Key words: Korea, *Physocarpus*, Rosaceae, *Spiraea*, Ulleung Island.

Physocarpus (Cambess.) Raf. is a small genus with about six species in Rosaceae (Oh & Potter, 2005). The genus, which is distributed in East Asia and North America, is characterized by having stipulate simple leaves, fused carpels at least at the base, inflated follicular fruits dehiscent along both the ventral and dorsal sutures, copious endosperm, and stellate trichomes. North America has the greatest diversity with four species in western North America and one in eastern North America: the eastern North American *P. opulifolius* (L.) Maxim. is widely cultivated as an ornamental. In East Asia, *P. amurensis* (Maxim.) Maxim. occurs in thickets in mixed coniferous forests of North Korea, northeastern China, and the Far Eastern Federal District of Russia.

Physocarpus insularis (Nakai) Nakai has been known as a rare species in East Asia (Nakai, 1918) and is endemic on Ulleung Island. This very small volcanic island is located in the East Sea of Korea (Sea of Japan) about 150 km east of the Korean Peninsula with an area of about 73 km² and a maximum elevation of 984 m above sea level. The vegetation on this island is primarily temperate broadleaf deciduous forest often mixed with conifers and evergreen shrubs. It is a biodiversity hotspot with approximately 700 species of vascular plants, 41 of which are endemic on the island (Sun & Stuessy, 1998).

Classification of *Physocarpus insularis* has been problematic, however. The insular species was synonymized under *Spiraea chamaedryfolia* L. var. *ulmifolia* (Scop.) Maxim. by Kim et al. (2000), whereas all floristic studies of Korea recognized it as a distinct species in *Physocarpus* (Chung, 1957; Lee, 1980; Lee, 2007). As part of our systematic studies of vascular plants on Ulleung Island, we examined the systematics of *P. insularis* based on morphology and DNA sequences (Oh et al., 2010).

The results suggested that *Physocarpus insularis* should be recognized as a distinct taxon within *Spiraea* L. (Oh et al., 2010). Comparative morphology revealed that *P. insularis* exhibits all the diagnostic characters of *Spiraea*. Leaves are unlobed and do not have stipules. Nectaries form conspicuous lobes at the rim of the hypanthium. Carpels are free, and the follicular fruits dehisce along the ventral suture only. Phylogenetic analyses of chloroplast DNA (cpDNA) regions (*rbcL*, *matK*, *ndhF*, and *trnL-trnF*) with exemplars representing major lineages of Rosaceae confirmed that our accession identified as *P. insularis* is nested within *Spiraea*. Further phylogenetic analyses of *trnL-trnF* and ITS data with additional species-level samples of *Spiraea* suggested that *P. insularis* is closely related to *S. chamaedryfolia*, a taxon distributed from Europe to East Asia.

Physocarpus insularis is readily distinguished from *Spiraea chamaedryfolia* by the size and shape of the leaf blade, the type of leaf base, and the number of stamens. The length and width of leaf blades of *P. insularis* are significantly larger than those of *S. chamaedryfolia*. Leaf blades of *P. insularis* are broadly ovate and subcordate, truncate, or occasion-

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ally rounded at the base, while those of *S. chamaedryfolia* are narrowly ovate or elliptical and briefly attenuate or rounded at the base. The ratio of leaf length to width ranges from 1.09 to 1.50 in *P. insularis*, while the ratio in *S. chamaedryfolia* ranges from 1.45 to 2.38, reflecting the different leaf shapes of the two species. *Physocarpus insularis* has a higher stamen number, with 60 to 70 stamens per flower, than observed for *S. chamaedryfolia*, which contains 20 to 50 stamens per flower.

Spiraea insularis (Nakai) H. Shin, Y. D. Kim & S. H. Oh, comb. nov. Basionym: *Opulaster insularis* Nakai, Bot. Mag. (Tokyo) 32: 104. 1918. *Physocarpus insularis* (Nakai) Nakai, Bull. Natl. Sci. Mus. Tokyo 31: 56. 1952. TYPE: Korea. Kyungsangbuk-do, Ulleung Island, Do-dong, 1 June 1917, *T. Nakai 4344* (holotype, TI).

Discussion. This species was originally described in the genus *Opulaster* Medik. ex C. K. Schneid. (Nakai, 1918) and later transferred to *Physocarpus* (Nakai, 1952), an earlier name that has priority over the illegitimate name *Opulaster*. The holotype specimen as noted by Nakai for *O. insularis* contains only sterile branches without flowering or fruiting material. Nakai (1919) noted that the leaves were similar to those of the western North American *P. monogynus* (Torr.) J. M. Coult. However, the diagnostic characters of *Physocarpus*, such as stipules and stellate hairs, are absent in the holotype specimen.

Spiraea insularis is a shrub ca. 1 m tall, known primarily from the west-facing hills near the port of Do-dong on Ulleung Island. Most individuals in the population grow on the rocky slopes at about 200 m elevation, associated with *Abelia insularis* Nakai and *Cotoneaster wilsonii* Nakai. The natural habitat of these endangered species in the Do-dong area has been designated as a Natural Monument in Korea. Because most plants of *S. insularis* grow within the protected area, it is unlikely that the population of *S. insularis* will be disturbed by anthropogenic activities. However, because the slopes are very steep, the plant community is vulnerable to soil erosion especially due to typhoons.

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Manglietia crassifolia (Magnoliaceae), a New Species from Vietnam

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Abstract. *Manglietia crassifolia* Q. N. Vu, N. H. Xia & Sima, a new species of Magnoliaceae from Lao Cai Province in northern Vietnam, is described and illustrated. It is most closely related to *M. dandyi* (Gagnep.) Dandy and *M. megaphylla* Hu & W. C. Cheng, but differs in its broadly ovoid terminal buds, the thickly leathery leaf blade that is abaxially densely villous with appressed, ferruginous-brown, matted hairs, the purplish cream outermost tepals, the glabrous and purplish red stamens with obtuse appendages, and the ellipsoid, very short-beaked fruits.

Key words: IUCN Red List, Magnoliaceae, *Manglietia*, Vietnam.

The genus *Manglietia* Blume (Magnoliaceae, Magnolioideae) was established by Blume (1823) on the basis of its young leaves conduplicate in bud, flowers terminal, stipules adnate to petioles, and ovules four or more per carpel. According to the modern generic circumscription by Xia et al. (2008), this genus includes more than 40 species distributed in tropical and subtropical regions of southeastern Asia, and ca. 12 are currently known from Vietnam.

During a botanical expedition made by the first author in August 2008 to the Hoang Lien National Park, Sa Pa District, Lao Cai Province, in northern Vietnam, several herbarium vouchers of *Manglietia* deposited in the park's Biodiversity Center were examined for identification. One collection, *Nguyen Ba Dien HL 69*, made from the San Sa Ho commune in 2005 was noteworthy for its vegetative aspects, but lacked flowers and fruits. The leaf blade was broadly elliptic in outline, with its abaxial surface and the terminal buds densely villous with appressed, ferruginous-brown, matted hairs. Later, in September 2009, specimens of the Magnoliaceae collected from Hoang Lien National Park were sent to the first author for identification. One of these, *Wen et al. 10834*, had flowers, and its vegetation matched perfectly with the aforementioned collection *Nguyen Ba Dien HL 69*. In December 2009 and October 2010, the first author successfully collected fruiting specimens (*Nam 181209.3 & 31010*). After careful comparison with other species in *Manglietia*, we found that the plant could not be referred to any of the previously described taxa, and thus is here described as a new species.

Manglietia crassifolia Q. N. Vu, N. H. Xia & Sima, sp. nov. TYPE: Vietnam. Lao Cai Prov.: Sa Pa Distr., Hoang Lien Natl. Park, 1890 m, 22°21′28.9″N, 103°46′53.8″E, 18 Dec. 2009, *V. Q. Nam 181209.3* (holotype, VNF; isotype, IBSC). Figures 1, 2.

Species nova *Manglietiae dandyi* (Gagnep.) Dandy et *M. megaphyllae* Hu & W. C. Cheng arcte affinis, sed ab eis gemmis terminalibus late ovoideis usque ellipsoideo-ovoideis, foliorum laminis crasse coriaceis abaxialiter densissime appresseque ferrugineo-brunneo-villosis, tepalis exterioribus purpurascentibus, staminibus glabris purpurascenti-rubris appendicibus obtusis atque fructibus ellipsoideis brevissime rostratis differt.

Evergreen trees, to 8–15 m tall, to 20 cm diam., trunks rounded, branched; bark grayish brown, not

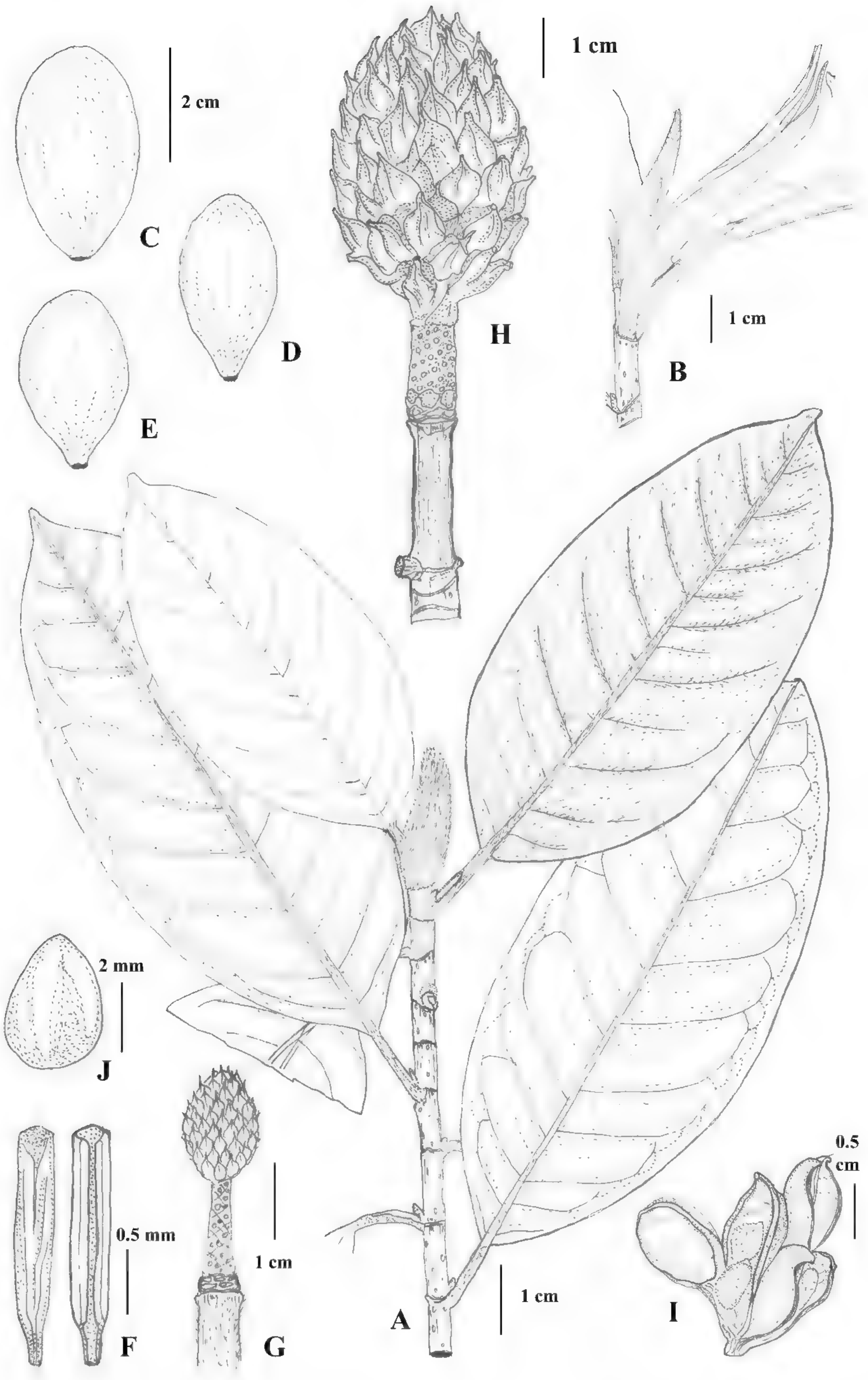

Figure 1. *Manglietia crassifolia* Q. N. Vu, N. H. Xia & Sima. —A. Habit. —B. Terminal bud and stipule. —C. Tepal of outer whorl. —D, E. Tepals of inner whorls. —F. Stamens. —G. Gynoecium. —H. Fruit. —I. Dehiscent carpels. —J. Seed. Drawn by Vu Quang Nam. A, B, H–J drawn from the holotype *Nam 181209.3* (VNF); C–G from *Wen et al. 10834* (Center for Plant Conservation, Vietnam Union of Science and Technology Association).

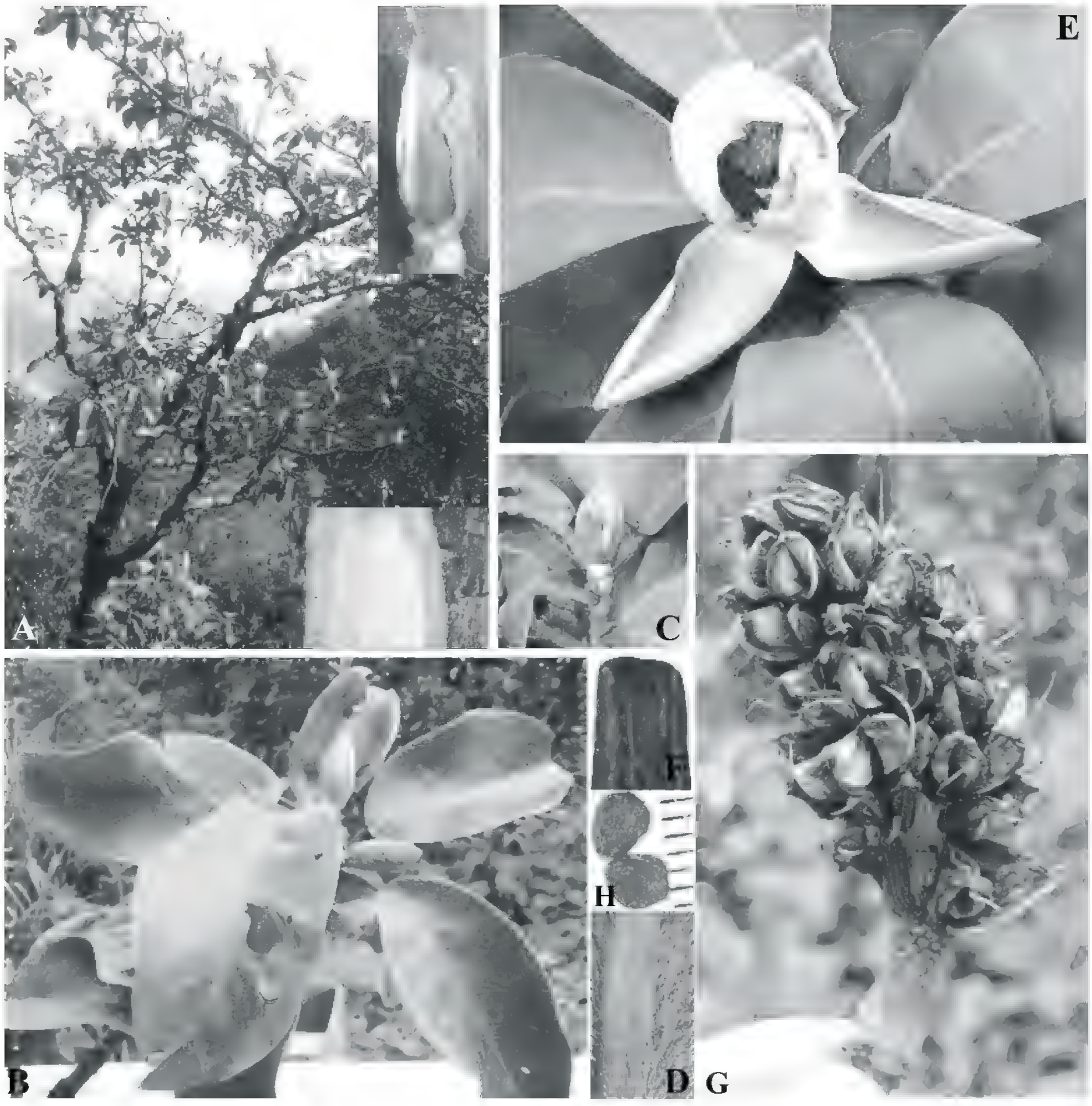

Figure 2. *Manglietia crassifolia* Q. N. Vu, N. H. Xia & Sima. —A. Habit, with insets showing bark (lower right) and vegetative bud, showing leaves conduplicate in bud (upper right). —B. Branch apex with leaves and bud. —C. Terminal bud and adaxial view of petioles, showing stipular scars. —D. Abaxial leaf surface, showing the dense, appressed, matted hairs. —E. Apical view of flower. —F. Stamen apex, showing the short obtuse appendage. —G. Fruit. —H. Seeds. Photo in E taken by Nguyen Quang Hieu (Center for Plant Conservation, Vietnam Union of Science and Technology Association); other photos by Vu Quang Nam. A–D, H from *Nam 181209.3* (VNF); E, F from *Wen et al. 10834* (Center for Plant Conservation, Vietnam Union of Science and Technology Association); G from *Nam 31010* (VNF).

fissured; cortex fleshy, yellowish white, pith white. Leaves spirally arranged, conduplicate in bud; vegetative buds, abaxial leaf blade surfaces, petioles, stipules, peduncles, pedicels, and spathaceous bracts densely ferruginous-brown villous; young twigs 5–7 mm diam., glabrescent and lenticellate when mature. Vegetative buds broadly ovoid to elliptic-ovoid, 2–4 × 1.3–1.6 cm; stipules adnate to the petiole, stipular scars 7–13 mm, extending 1/2 to 2/3 of petiole length; petioles 1.6–3 cm, leaf blades thickly leathery or coriaceous, broadly elliptic to elliptic, (10–)15–17(–21) × (5–)7–8 cm, adaxially glabrous, dark green, abaxially very densely villous with appressed, ferruginous-brown, matted hairs, blade bases rounded to broadly cuneate, apex acuminate with an acumen 4–12 mm; blade margins recurved; secondary veins 9 to 15 on each side of the midrib, oblique, adaxially obscure, abaxially conspicuous, reticulation abaxially obscured by the dense indumentum; blade midrib and margin bright yellowish green when fresh. Peduncles ca. 1.7 × 0.5 cm in flowering material, glabrescent with maturity, lengthening to 1.8–2 × 0.5–0.8 cm in

Table 1. Differences in morphological characters among *Manglietia crassifolia*, *M. dandyi*, and *M. megaphylla*.

	M. crassifolia	*M. dandyi*	*M. megaphylla*
Terminal buds	broadly ovoid to elliptic-ovoid, 2–4 × 1.3–1.6 cm	ellipsoid, ca. 3.5 × 1 cm	ellipsoid, 3–5 × ca. 1.5 cm
Leaf blade	broadly elliptic to elliptic, (10–)15–17(–21) × (5–)7–8 cm, abaxially very densely villous, rusty brown in color	obovate to obovate-elliptic, 17–21.5 × 5.5–9.5 cm, abaxially somewhat villous, rusty in color	obovate, 25–50 × 10–20 cm, abaxially tomentose to sparsely pubescent, rufous in color
Secondary veins on each side of midrib	9 to 15	12 to 14(to 16 or 18)	17 to 24
Leaf acumen	0.4–1.2 cm	1.8–2 cm	1–1.5 cm
Outer tepals	purplish cream, 3.7–4.2 cm	white, ca. 2.7 cm	pale green, obovate-oblong, 4.5–5 cm
Stamens	purplish red, glabrous	color not known, sparsely pubescent outside	red to cream-red, sparsely pubescent outside
Stamen appendage	obtuse	triangular	triangular
Fruiting peduncles at maturity	1.8–2 × 0.5–0.8 cm	2–4.5 × ca. 0.5 cm	2.5–7.5 × 1.2–1.5 cm
Pedicels	0–2 mm	0–2 mm	0–1.5 cm
Fruits	ellipsoid, 4.5–6 × 2.8–3.5 cm	globose to subglobose, 6.5–8 × 5.5–7 cm	globose to subglobose, 7–12 × 6.5–10.8 cm
Fruiting beak	1–2 mm, slightly recurved	ca. 7 mm, recurved	7–10 mm, recurved
Scar of perianth and stamens	ca. 1.6 cm	ca. 1.7 cm	ca. 1.5 cm
Number of mature carpels	73 to 102	24 to 40	57 to 65

fruiting material; pedicels absent or < 2 mm long; spathaceous bract 1. Flowers terminal, solitary, generally cream-white, glabrous; tepals 9 in 3 whorls, the 3 outer tepals oblong to obovate, 3.7–4.2 × 2.5 cm, purplish cream, margin wavy, those of the inner whorls slightly smaller, obovate, thickly fleshy, cream-white; stamens numerous, purplish red, glabrous, ca. 16 × 2 mm; filaments ca. 3 mm, the connective continued into an obtuse appendage, introrsely dehiscent; gynoecium narrowly ovoid to ellipsoid, ca. 1.6 × 1.2 cm, pubescent. Fruits ellipsoid, 4.5–6 × 2.8–3.5 cm, very briefly rostrate; stamen and perianth scars ca. 1.6 cm in fruit; mature carpels 73 to 102, 0.7–1.3 × ca. 0.6 cm, dehiscing along the dorsal sutures and later along the ventral sutures, beaks acute and slightly recurved when dry, 1–2 mm long; seeds 4 or more per carpel, ovoid, ca. 7 × 6 mm.

Distribution and habitat. *Manglietia crassifolia* is currently only known from the Hoang Lien National Park, Sa Pa District, Lao Cai Province, Vietnam. The new taxon was found in evergreen broad-leaved forests on limestone mountains at altitudes of ca. 1800–2000 m.

IUCN Red List category. Because *Manglietia crassifolia* is known only from one locality and the population size is very small (less than 50 mature individuals), it is assessed here as Critically Endangered (CR), according to IUCN Red List criteria (IUCN, 2001).

Phenology. *Manglietia crassifolia* was observed in flower from April to May and in fruit from August to November.

Vernacular name. Mõ lông dày (referring to its matted hairy indumentum).

Taxonomic notes. The new species is assigned to *Manglietia*, according to the generic circumscription by Xia et al. (2008), and to *Manglietia* sect. *Manglietia*, according to the generic circumscription by Chen and Nooteboom (1993), on the basis of its young leaves conduplicate in bud, flowers terminal, stipules adnate to petioles, and ovules four or more per carpel.

Manglietia crassifolia is a distinctive species, distinguished by its broadly ovoid terminal buds, the thickly leathery leaf blade that is abaxially densely villous with appressed, ferruginous-brown, matted hairs, the purplish cream outer tepals, the glabrous and purplish red stamens with obtuse appendages, as well as the ellipsoid, very shortly beaked fruits. The new species is most likely related to *M. dandyi* (Gagnep.) Dandy (Praglowski, 1974), which has similar leaf size and indumentum, and to the sympatric species *M. megaphylla* Hu & W. C. Cheng (Hu & Cheng, 1951). These taxa also belong in *Manglietia* sect. *Manglietia*, and all three species are compared in Table 1.

Paratypes. VIETNAM. **Lao Cai:** Sa Pa Distr., Hoang Lien Natl. Park, *V. Q. Nam 31010* (IBSC, MO, VNF), *Nguyen Ba Dien HL 69* (Biodiversity Center, Hoang Lien

Natl. Park), *J. Wen, N. T. Hiep & N. Q. Hieu 10834* (Center for Plant Conservation, Vietnam Union of Science and Technology Association).

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Davallia napoensis, a New Species of Davalliaceae from Guangxi, China

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ABSTRACT. During preparation of the taxonomic treatment of Davalliaceae for the *Flora of China*, it was noticed that specimens of *Davallia* Sm. collected from Guangxi Province, China, differed from other known species in the Davalliaceae. *Davallia napoensis* F. G. Wang & F. W. Xing is herein described and illustrated as new to science. It is morphologically similar to *D. solida* (G. Forst.) Sw., but differs mainly by its rhizome scales that are triangular, with an obtuse apex and glabrous margin, the petiole of the lamina 20–24 cm long, and the widely crateriform and basifixed indusium.

Key words: China, *Davallia*, Davalliaceae, IUCN Red List.

The genus *Davallia* Sm. (Davalliaceae), with about 45 species, is widely distributed from the Atlantic islands through Africa and southern Asia to Malesia, southeast to Polynesia (Nooteboom, 1996; Wu, 1999; Von Konrat et al., 1999). Kato (1985) provided a very detailed history of the generic delimitation until that time. The family Davalliaceae was historically classified into eight genera by Copeland (1908, 1927). Later, Kato (1985) recognized seven genera, with *Davallia* divided into three sections: section *Cordisquama* M. Kato, section *Davallia*, and section *Wibelia* (Bernh.) M. Kato, largely based on characters associated with the rhizome scales; in this classification, the generitype for *Humata* Cav. (*H. ophioglossa* Cav.), as well as several other species of *Humata* [– *Davallia* sect. *Humata* (Cav.) C. Presl], are included in *Davallia* sect. *Wibelia*. In 1989, Kato included *Scyphularia* Fée in *Davallia*; species formerly belonging to *Araiostegia* Copel. and *Humata* were also incorporated in *Davallia* (Nooteboom, 1996). More recently, Kato and Tsutsumi (2008) divided *Davallia* into only two sections: section *Davallia* and section *Trogostolon* (Copel.) M. Kato & Tsutsumi, of which the former section included *Scyphularia*. There are about nine species of *Davallia* mainly distributed in southern and southwestern China (Ching et al., 1959; Wu, 1999; Wang & Xing, 2008).

During preparation of the taxonomic treatment of Davalliaceae for the *Flora of China*, Volume 3, specimens of *Davallia* were collected and observed, some of which differed from established species in the genus. The new species is immediately distinguished by its rhizome scales that are triangular and obtuse at the apex, and indusia that are broadly bowl-shaped.

Davallia napoensis F. G. Wang & F. W. Xing, sp. nov. TYPE: China. Guangxi Prov.: Napo Co., Baidou, Nongbulin, near peak of evergreen broad-leaved forests, ca. 1200 m, 20 May 1989, *South China Expedition 841* (holotype, IBSC). Figure 1.

Species *Davalliae solidae* (G. Forst.) Sw. affinis, sed ab ea rhizomatibus 4–5 mm crassis squamis triangulatis apice obtusis marginibus glabris, stipite 20–24 cm longo, lamina late triangulato-ovata basi subrotundata segmentis ultimis ovato-triangulatis apice acutis atque indusio minore late crateriformi basifixo differt.

Plants 45–52 cm tall; rhizome robust, long-creeping, 4–5 mm thick, woody, dorsiventral, densely covered with overlapping scales; rhizome scales triangular, 4–5 × ca. 2 mm, margin glabrous, base truncate, apex attenuate to obtuse, rufous, peltate. Leaf remote, 2–4 cm apart on the rhizome; petiole 20–24 cm long, ca. 2 mm thick, brown, finely grooved adaxially, base densely covered with scales similar to those on the rhizome, sparser apically; lamina broadly triangular-ovate, 25–28 × 18–22 cm, base nearly rounded, apex acuminate, tripinnate or basally 4-pinnate pinnatifid; pinnae in 11 to 13 pairs, obliquely upward, spaced closely together, alternate or basal 1 or 2 pairs subopposite, with stalk 3–20 mm long, basal pair of pinnae largest, narrowly triangular-lanceolate, 15–16 × 4.5–5.5 cm, base broadly cuneate, apex long acuminate, with basal stalk ca. 2 cm long, bipinnate; pinnules in 10 to 12 pairs, alternate, anadromous, with a shortened petiole 5–6 mm, obliquely upward, spaced closely together, the basal pinnule largest, 1.8–2.1 × 0.7–0.9 cm, asymmetrically cuneate; ultimate leaflets in 6 to 8 pairs, alternate, with brief petiole or subsessile, obliquely upward and closely opposed, the basal leaflet larger, 0.9–1.6 × 0.5–1 cm, ovate-triangular,

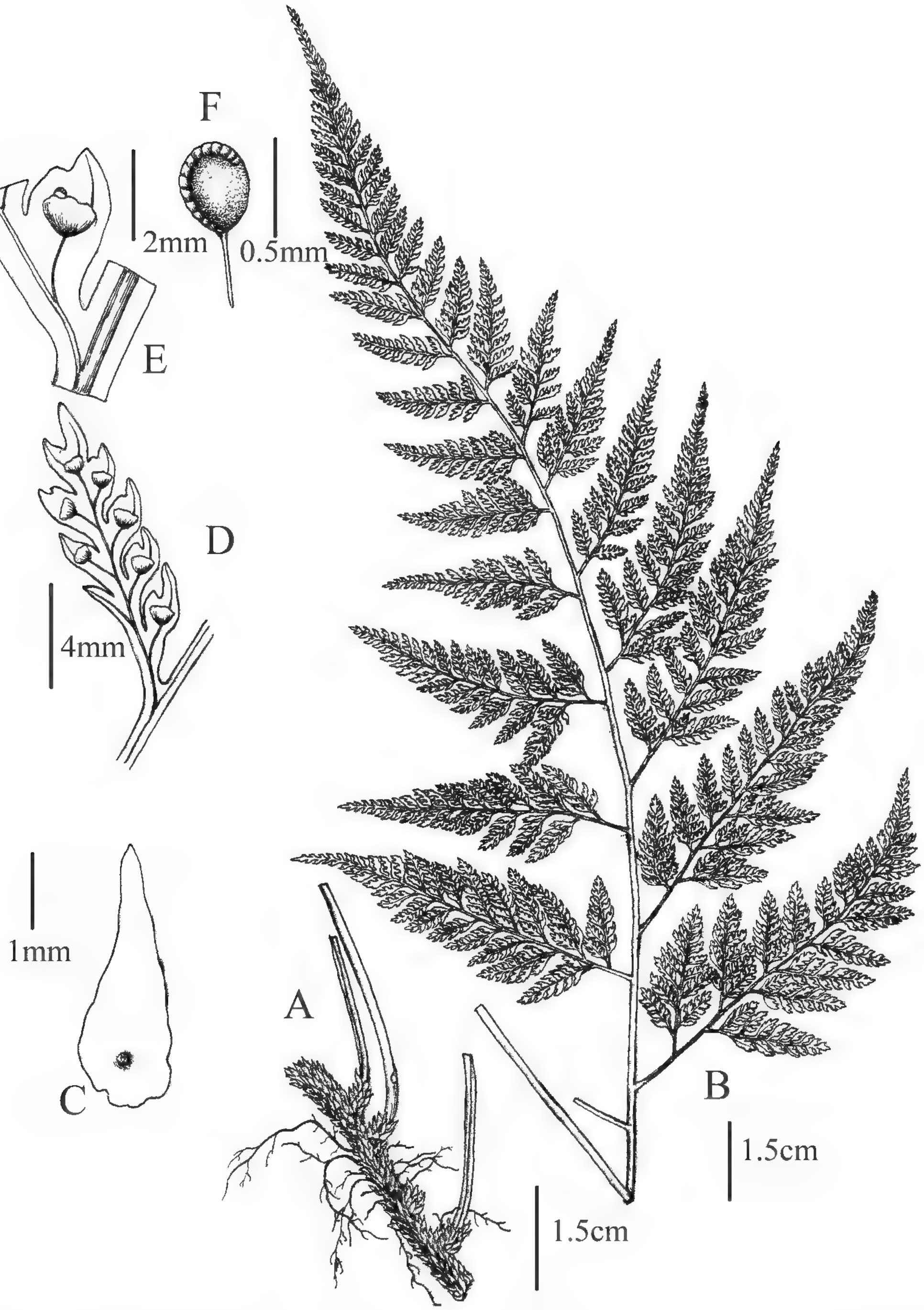

Figure 1. *Davallia napoensis* F. G. Wang & F. W. Xing. —A. Rhizome. —B. Leaf. —C. Rhizome scale. —D. Pinnule. —E. Ultimate lobes, with indusium. —F. Spore. Drawn by Yun-xiao Liu from the holotype *South China Expedition 841* (IBSC).

base obliquely cuneate and decurrent, apex acute; lobes entire, apex obtuse or with sinus, 3–4 × ca. 1 mm; upper pinnae gradually shortened, lanceolate, 3-pinnate and shallowly pinnatifid, lobes entire, terminal pinnae shortened to ovate-triangular, close together; veins inconspicuous, veinlets simple or forked, false veins absent; frond coriaceous or firmly papyraceous, brown when dry, smooth. Sori separate,

borne always one on the middle of pinnae segment; indusium widely crateriform, ca. 0.4 × 0.6 mm, entire, brown, membranous, basifixed, both sides free; annulus longitudinal, consisting of 13 to 16 thickened cells; spores monolete, elliptic, translucent.

Distribution and habitat. *Davallia napoensis* is currently known only from one locality in Napo County, Guangxi Province, China. It is an epiphytic fern and grows in humid environments on limestone substrates near the summit of a mountain, at ca. 1200 m elevation. The new taxon was found in association with the fern *Asplenium prolongatum* Hook. (Aspleniaceae), as well as *Ilex kwangtungensis* Merr. (Aquifoliaceae), *Ophiorrhiza japonica* Blume and *Porterandia sericantha* (W. C. Chen) W. C. Chen (Rubiaceae), *Rotala rotundifolia* (Buch.-Ham. ex Roxb.) Koehne (Lythraceae), *Stenoseris graciliflora* (Wall. ex DC.) C. Shih (Asteraceae), and *Tupistra fungilliformis* F. T. Wang & S. Yun Liang (Liliaceae).

IUCN Red List category. *Davallia napoensis* is only known from a single locality and has a small population size. Therefore, it is assessed here as Critically Endangered (CR) according to IUCN Red List criteria (IUCN, 2001).

Etymology. The specific epithet is derived from Napo County, where the holotype of *Davallia napoensis* was collected.

Taxonomic relationships. According to the sectional classification of Kato and Tsutsumi (2008), *Davallia napoensis* should be assigned to *Davallia* sect. *Davallia*, based on the glabrous scale margin and the basifixed indusia.

Morphologically, *Davallia napoensis* closely resembles *D. solida* (G. Forst.) Sw. (Wu, 1999: plate 32, 1–6), which is widely distributed in Guangdong, Guangxi, Yunnan, and Taiwan provinces of China, as well as Burma, Malesia, the Philippines, Polynesia, and Thailand, in dense forests at altitudes of 500–1400 m. *Davallia solida* is distinguished by having tripinnate fronds (vs. tripinnate or basally 4-pinnate pinnatifid in *D. napoensis*), a more robust rhizome that is also long-creeping, and brown (vs. rufous), overlapping rhizome scales. *Davallia solida* is further differentiated by the thicker rhizome, 8–10 mm diam. (vs. 4–5 mm diam. in *D. napoensis*); the ovate-lanceolate rhizome scales, 5–7 mm long, with a long subulate apex and ciliate margin (vs. triangular rhizome scales, with an attenuate to obtuse apex and glabrous margin); the petiole 15–18 cm long (vs. 20–24 cm); the lamina quinquangular (vs. broadly triangular-ovate) with the base cordate (vs. nearly rounded); the elliptic ultimate leaflets with an obtuse apex (vs. ovate-triangular leaflets with an acute apex); and the indusia attached along the sides, tubular, and longer than wide, 1.2–2 × 0.5–1 mm (vs. smaller indusia that are basifixed, crateriform, ca. 0.4 × 0.6 mm in *D. napoensis*). Another similar species is *D. formosana* Hayata (Ching et al., 1959; Wu, 1999), distributed in Fujian, Guangdong, Guangxi, Hainan, Taiwan, and Yunnan provinces in China and south into Vietnam and Cambodia in forests at 600–700 m altitude. *Davallia formosana* is similar to *D. napoensis* in its general plant aspect, but is distinguished by its widely lanceolate, shaggy rhizome scales, with a long acuminate apex and ciliate margin, ca. 1 cm long; its tubular indusium attached along the sides, ca. 1 × 2 mm; its rhizomes ca. 1 cm thick; and its petioles 25–55 cm long. *Davallia formosana* is the largest of the three species, with fronds 4-pinnate, triangular or ovate-triangular, 55–90 × 55–90 cm, and with a cordate base.

Davallia napoensis is also similar to *D. griffithiana* Hook. (Wu, 1999), which is distributed in Yunnan and Taiwan provinces in China and in India climbing on trunks or rocks in wet forest. *Davallia griffithiana* resembles *D. napoensis* in having a long-creeping rhizome and widely crateriform indusium, but is distinguished by its linear-lanceolate rhizome scales with a long acuminate apex (vs. triangular with an attenuate to obtuse apex), its petiole 10–15 cm long (vs. 20–24 cm long), the lamina 16–25 cm long (vs. 25–28 cm long), and the indusium attached by the base and at least halfway along the sides (vs. basifixed with both sides free).

Spore morphology observations show that the epispore of *Davallia napoensis* and related species are irregularly verrucate, with obviously smooth verrucae that differ in size (Fig. 2). However, the spore verrucae of *D. napoensis* are smooth, whereas those of *D. solida*, *D. griffithiana*, and *D. formosana* have a thin, rough covering.

Paratypes. CHINA. **Guangxi:** Napo Co., Baidou, Nongbulin, near peak of evergreen broad-leaved forests, *South China Expedition 841* (IBSC).

Representative specimens of compared species include:

Davallia solida (G. Forst.) Sw. CHINA. **Yunnan:** Hekou, *K.-H. Cai 1184* (PE); Guangxi, Yao Mtn., *Y.-C. Wu 651* (PE). VIETNAM. 3 islands, *Sino-Vietnam Exped. 2086* (PE).

Davallia griffithiana Hook. CHINA. **Taiwan:** Wenshan, *Tarako et al. 136* (PE). **Yunnan:** Xichou, *Z.-R. Wang 498* (PE).

Davallia formosana Hayata. CHINA. **Guangdong:** Luofu Mtn., *N.-Q. Chen 41276* (IBSC). **Hainan:** Bawangling, *Z.-X. Li 3566* (IBSC). **Yunnan:** s. loc., *G.-H. Shing et al. 6179-3* (PE).

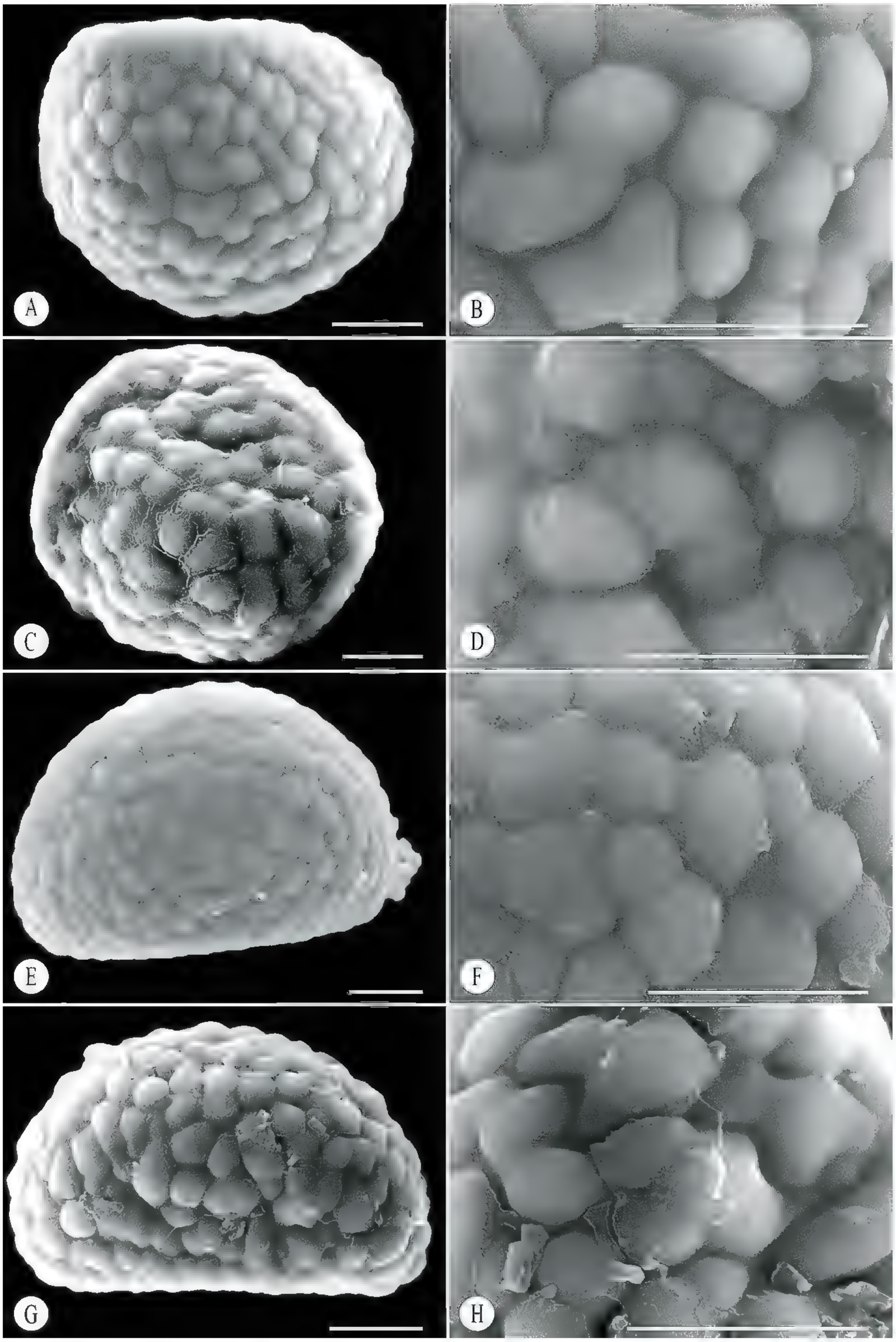

Figure 2. SEM photographs of *Davallia* spores. —A, B. *D. napoensis* (spore from the holotype of *South China Expedition 841* [IBSC]: A, ×1900; B, ×6000). —C, D. *D. solida* (spore from *K.-H. Cai 1184* [PE]: C, ×1800; D, ×6000). —E, F. *D. griffithiana* (spore from *Z.-R. Wang 498* [PE]: E, ×1900; F, ×5500). —G, H. *D. formosana* (spore from *G.-H. Shing et al. 6179-3* [PE]: G, ×1700; H, ×6000). Scale bars = 10 μm.

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Petrocosmea huanjiangensis, a New Species of Gesneriaceae from Limestone Areas in Guangxi, China

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ABSTRACT. A new species of Gesneriaceae, *Petrocosmea huanjiangensis* Yan Liu & W. B. Xu, is described and illustrated from northern Guangxi, China. The new species is related to *P. martini* (H. Lév.) H. Lév. but is distinguished on the basis of the peltate leaf blade, the densely lanate androecial filaments 6–7.2 mm long, the rostellate, cordate-ovoid anthers that are constricted near the apex, and the three staminodes, 2–3 mm long.

Key words: China, Gesneriaceae, Guangxi, IUCN Red List, limestone flora, *Petrocosmea*.

The genus *Petrocosmea* Oliv. (Gesneriaceae, Cyrtandroideae), with about 24 species and four varieties, is distributed in China (Wang et al., 1998), but only three species are known from Guangxi Province: *P. iodioides* Hemsl., *P. minor* Hemsl., and *P. martini* (H. Lév.) H. Lév. In the course of our floristic investigation of Huanjiang County in northern Guangxi, a rare plant of *Petrocosmea* was collected with a peltate leaf base, which differed from other known species. After comparison with all described species of *Petrocosmea* (Wang, 1985; Wang, 1990; Wang et al., 1998; Li & Wang, 2004; Wei & Wen, 2009), we confirm that the collection represents a new and fourth species from Guangxi, which is described below.

Petrocosmea huanjiangensis Yan Liu & W. B. Xu, sp. nov. TYPE: China. Guangxi Zhuang Autonomous Region: Huanjiang Co., on moist limestone rock face in forest of limestone hills, 3 June 2009, *Yan Liu & Wei-bin Xu 09549* (holotype, IBK; isotype, PE). Figure 1.

Species *Petrocosmeae martini* (H. Lév.) H. Lév. similis, a qua foliis basi peltatis, filamentis 6 7.2 mm longis dense lanatis, antheris cordato-ovoideis apicem versus constrictis apice rostellatisatque staminodiis 3, 2 3 mm longis differt.

Herbs perennial; rhizome subterete, 5–6 × ca. 6 mm. Leaves 5 to 8, basal, long petiolate; petioles 2–6.5 cm, patently pilose; leaf blade herbaceous, ovate or broadly ovate to subrotund, 1.5–3.5 × 1.5–2.5 cm, apex obtuse or rounded, margin crenate or repand, peltate with the petiole attaching 6–12 mm within the lamina, patently pilose on both sides, lateral veins adaxially impressed, abaxially conspicuous, 3 to 5 on each side. Cyme 1- to 3-flowered, peduncle 5–6.5 cm, patently pilose; bracts 2, opposite, linear or narrowly lanceolate, 2–4 × 0.5–1 mm, margin entire, apex acute, patently pilose; pedicel 4–12 mm, patently pilose. Calyx 5-lobed nearly to the base, lobes narrowly lanceolate, 4–6 × 1.5–2 mm, margin entire, outside patently pilose, inside glabrous; corolla blue, 1.3–2 cm, externally pubescent, internally glabrous; tube 5–7 × 6–8 mm (diam. at mouth), with 2 yellow stains inside; adaxial lip ca. 5 mm, inconspicuously 2-lobed; abaxial lip ca. 12 mm, 3-lobed to or above the middle, the middle lobe subrotund, lateral lobes broadly ovate; stamens 2, adnate to the corolla base; filaments 6–7.2 mm, linear, densely lanate; anthers cordate-ovoid, ca. 2.5 mm, glabrous, constricted near the apex, rostellate; staminodes 3, glabrous, adnate to 0.5 mm above corolla base, lateral staminodes ca. 3 mm, middle one ca. 2 mm; pistil 8–13 mm, ovary ca. 2.5–3.5 mm, densely puberulent; style 5–6.5 mm, puberulent; stigma capitate. Capsules not seen.

Distribution and ecology. The new species was found on moist rock faces within forests on limestone hills. It was collected only in Huanjiang County, from northern Guangxi Province, China, at ca. 750 m elevation.

IUCN Red List category. Current information shows that the population size of this new species is fewer than 250 mature individuals, and it is only known from one site. We therefore assess *Petrocosmea huanjiangensis* as Critically Endangered (CR) according to IUCN Red List categories and criteria (IUCN, 2001). Its distributional range is apparently narrow and the population size small; however, the type locality occurs within the Mulun National Natural Reserve and is therefore under protection.

Phenology. *Petrocosmea huanjiangensis* was observed in flower during May and June.

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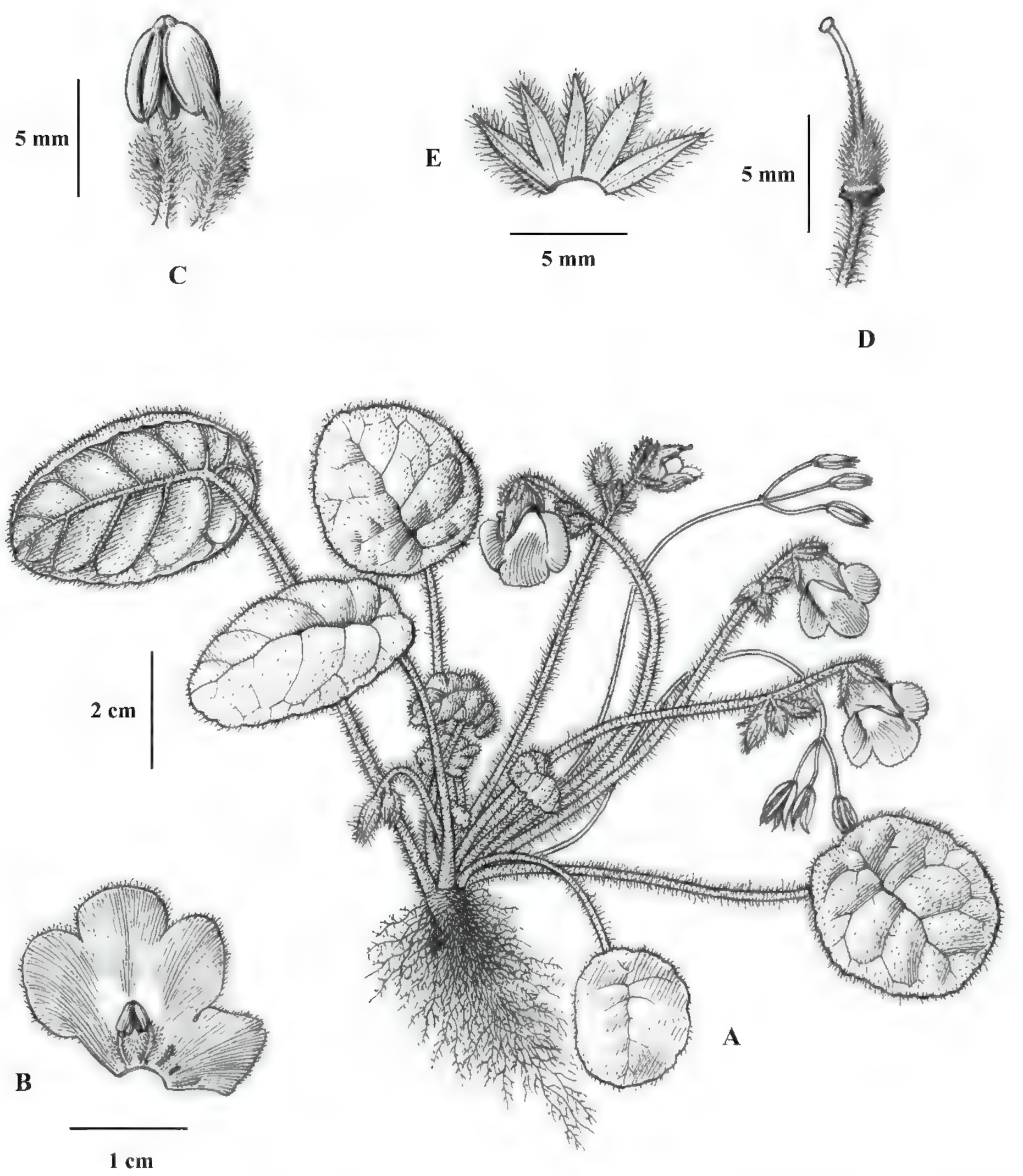

Figure 1. *Petrocosmea huanjiangensis* Yan Liu & W. B. Xu. —A. Habit. —B. Corolla dissected to reveal stamens and staminodes. —C. Stamens. —D. Pistil. —E. Calyx. Drawn by S. Q. He from the holotype *Yan Liu & W. B. Xu 09549* (IBK).

Etymology. The epithet of the new species refers to the type locality of Huanjiang County.

Discussion. The most comprehensive revision of *Petrocosmea* was done by Wang (1985), who recognized three sections: section *Petrocosmea* Oliv., section *Anisochilus* Hemsl., and section *Deinanthera* W. T. Wang. *Petrocosmea huanjiangensis* belongs to section *Anisochilus*, series *Iodiodes* W. T. Wang. This new species is similar to *P. coerulea* C. Y. Wu ex W. T. Wang in its peltate leaf base, but *P. coerulea* is found in southeastern Yunnan. It is also similar to *P. martini*, which is found in central Guizhou, southeastern Yunnan, and western Guangxi. A morphological comparison of *P. huanjiangensis*, *P. martini*, and *P. coerulea* is provided in Table 1.

Paratypes. CHINA. **Guangxi Zhuang Autonomous Region:** Huanjiang Co., 3 June 2009, *Yan Liu & Wei-bin Xu 09577* (IBK).

Acknowledgments. The authors are grateful to Fa-nan Wei (IBK) for the Latin diagnosis; Wen-geng Qin and Wei-ning Tan (Administration Bureau of Mulun National Natural Reserve) for their assistance in the field; and Shun-qing He (IBK) for the handsome drawing. This study was supported by the Western

Table 1. Morphological comparison of *Petrocosmea huanjiangensis*, *P. martini*, and *P. coerulea*.

	P. huanjiangensis	*P. martini*	*P. coerulea*
Leaf blade	ovate or broadly ovate to subrotund	ovate to orbicular-ovate	oblong to elliptic or elliptic-ovate
Petiole length	2–6.5 cm	0.5–3.5 cm	1.5–2.7 cm
Leaf base	peltate	cordate to rounded	peltate
Adaxial corolla lip	ca. 5 mm long, inconspicuously 2-lobed	ca. 3 mm long, inconspicuously 2-lobed	ca. 3.5 mm long, deeply 2-lobed
Filaments	filaments 6–7.2 mm long, densely lanate	2–3 mm long, rust-brown puberulent	ca. 1.2 mm long, puberulent above
Anthers	cordate-ovoid, rostellate, and constricted near the apex	oblong, not apically constricted	cordate-ovoid, not apically constricted
Staminodes	3, 2–3 mm long	2, ca. 0.8 mm long	2, ca. 0.6 mm long

Program for Fostering Personal Ability (Chinese Academy of Sciences [2007]) to Yan Liu.

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Fallopia multiflora var. *angulata*, a New Combination in the Polygonaceae from China

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ABSTRACT. Taxonomic evaluation of *Polygonum multiflorum* Thunb. var. *angulatum* S. Y. Liu (Polygonaceae) reveals that a new combination in *Fallopia* Adans. is necessary, and the name *F. multiflora* (Thunb.) Haraldson var. *angulata* (S. Y. Liu) H. J. Yan, Z. J. Fang & Shi Xiao Yu is proposed. The new variety differs from the typical one by its square branchlets with longitudinal ridges that are densely papillate and by its root tubers with a greater abundance of fibers and abnormal vascular strands evident in anatomical cross section.

Key words: China, *Fallopia*, Guangxi, Polygonaceae.

In *The Polygoneae of Eastern Asia*, Steward (1930) divided the family into three genera (*Antenoron* Raf., *Polygonum* L., and *Koenigia* L.), and *P. multiflorum* Thunb. was placed in *Polygonum* sect. *Tiniaria* Meisn. Liu (1959) later moved *P. multiflorum* along with *P. ciliinerve* (Nakai) Ohwi from section *Tiniaria* to section *Pleuropterus* (Turcz.) Haraldson within the genus. Based on its stems with a twining habit, *Fallopia* Adans. was later recognized as an independent genus (Haraldson, 1978), and *P. multiflorum* was transferred to the genus *Fallopia*, a taxonomic opinion that was subsequently recognized by Li (1998; Li et al., 2003) in the *Flora Reipublicae Popularis Sinicae*. *Fallopia multiflora* (Thunb.) Haraldson is a well-known herbal medicine in China, and its roots are called He Shou Wu in Chinese. This species has often been used as a tonic and an anti-aging herb in Chinese traditional medicine. Liu (1991) described *P. multiflorum* var. *angulatum* S. Y. Liu from Guangxi. This variety differs from the typical variety in its square branchlets with longitudinal ridges that are densely covered by papillate bodies; the immature leaf that is purple adaxially along the vein and abaxially, turning green at maturity; the larger flower (3–3.5 mm diam. at anthesis vs. 2–3 mm diam. in variety *multiflorum*); and the elliptic tepals that are unequal in size, with the outer three larger and winged on the abaxial surface, and the apex of the wings retuse (vs. apex entire in variety *multiflorum*). However, *P. multiflorum* var. *angulatum* was considered only a cultivated variant of *F. multiflora* in the *Flora of China* treatment of the Polygonaceae (Li, 1998).

We examined the bioactive components of *Polygonum multiflorum* Thunb. [= *Fallopia multiflora* (Thunb.) Haraldson var. *multiflora*] collected from seven provinces in China and compared these to two accessions of *P. multiflorum* var. *angulatum* from Tianyang County, Guangxi (Table 1). The bioactive components of variety *angulatum* differed remarkably from those of the typical variety (Fu et al., 2006; Yan et al., 2007). Our further investigation of their respective anatomies, morphologies, and ITS sequence data (Yan, unpublished data) supports *P. multiflorum* var. *angulatum* as distinct and its transfer to *Fallopia* is proposed here at the varietal level.

1. Fallopia multiflora (Thunb.) Haraldson, Symb. Bot. Upsal. 22(2): 77. 1978. Basionym: *Polygonum multiflorum* Thunb., Syst. Veg. (ed. 14) 379. 1784. TYPE: China. Yunnan: *Ducloux 485* (holotype, BS [fide Steward, 1930] not seen).

1a. Fallopia multiflora var. **multiflora.**

1b. Fallopia multiflora var. **angulata** (S. Y. Liu) H. J. Yan, Z. J. Fang & Shi Xiao Yu, comb. nov. Basionym: *Polygonum multiflorum* Thunb. var. *angulatum* S. Y. Liu, Acta Bot. Yunnan. 13(4): 390. 1991. TYPE: China. Guangxi: Lingyun, 23 Oct. 1989, *S. Y. Liu L89015* (holotype, KUN).

1c. Fallopia multiflora var. **ciliinervis** (Nakai) Yonekura & H. Ohashi, J. Jap. Bot. 72(3): 158. 1997. Basionym: *Pleuropterus ciliinervis* Nakai, Repert. Spec. Nov. Regni Veg. 13(363–367): 267–268. 1914. *Fallopia multiflora* var. *ciliinerve* (Nakai) A. J. Li, Fl. Reipubl. Popularis

Table 1. Voucher collections from China for *Fallopia multiflora*. Vouchers are deposited at GDMP.

Taxon	Voucher	Locality
Fallopia multiflora	*H. J. Yan Y05JL*	Guangdong, Deqing
	H. J. Yan Y05JG	Guangdong, Deqing
	H. J. Yan Y05SB	Guizhou, Shibing
	H. J. Yan Y05EMS	Sichuan, Mt. Emei
	H. J. Yan Y05JY	Henan, Jiyuan
	H. J. Yan Y05ES	Hubei, Enshi
	H. J. Yan Y05JGS	Jiangxi, Mt. Jinggang
	H. J. Yan Y05JX	Guangxi, Jingxi
	H. J. Yan Y05GZ	Guangdong, Guangzhou
Fallopia multiflora var. *angulata*	*S. Y. Liu Y05TY*	Guangxi, Tianyang
Polygonum multiflora var. *angulata*	*S. Y. Liu L89015* (KUN)	Guangxi, Tianyang

Sin. 25(1): 103. 1998, nom. illeg. superfl. TYPE: China. Liaoning: thickets in valleys, mtn. slopes, 13 July 1897, *V. Komarov 563* (holotype, GH).

1d. **Fallopia multiflora** var. **hypoleuca** (Nakai ex Ohwi) Yonek. & H. Ohashi, J. Jap. Bot. 72(3): 158. 1997. Basionym: *Polygonum hypoleucum* Nakai ex Ohwi, Acta Phytotax. Geobot. 7(3): 130. 1938. TYPE: Taiwan. Taipei: Hokuto, 1 Dec. 1913, *Urbain Faurie 762* (isotype, HAST).

To distinguish the varieties of *Fallopia multiflora* in China, a revised identification key is provided (based on Li et al., 2003).

A Revised Key to *Fallopia multiflora* in China

1a. Branchlets square in cross section .... variety *angulata*
1b. Branchlets circular.
  2a. Leaf blades abaxially glabrous.
    3a. Bracts triangular to ovate ..... variety *multiflora*
    3b. Bracts oblique, funnelform ..... variety *hypoleuca*
  2b. Leaf blade abaxially papillate along veins, but otherwise glabrate ..... variety *ciliinervis*

Methodology

Anatomy. Both handmade cross sections and microtome sections were made from root tubers at 1 cm diam. Transverse sections 8–12 μm thick were serially cut, and then dehydrated through an ethanol series. The sections were stained with safranin-fast green FCF, mounted on microscope slides, and embedded in Paraplast Plus medium (Zhengzhou Baisite Test Instruments Sales Co., Zhengzhou, China).

Stem cuticle ultrastructure. Stems were sampled from the approximate middle fourth to fifth internodes and cut into small tissue blocks, which were fixed in 2.5% glutaraldehyde at 4°C for 6 hours, then rinsed with 0.1 M phosphate buffer (pH 7.2) six times, and dehydrated through an ethanol series toward supercritical point drying. Stem samples were sputter-coated with gold and examined with a Hitachi S-520 scanning electron microscope (Hitachi Ltd., Tokyo, Japan).

Results

Stem morphology. Epidermal cells were rectangular, with their long axes parallel to the stem axis in *Fallopia multiflora* and *F. multiflora* var. *angulata*. Epidermal cuticles were striated in *F. multiflora* and *F. multiflora* var. *angulata*, and there were no obvious morphological differences in the ornamentation. Only in *F. multiflora* var. *angulata* was a twisting of the epidermal cells noted, with papillate ridges evident (Fig. 1A, B).

Root tuber anatomy. Transverse sections were similar among the samples for *Fallopia multiflora* with several layers of cork cells noted, filled with brown contents. The tuber cortex in *F. multiflora*, scattered with four to 11 abnormal vascular bundles in *F. multiflora* with fewer vessels evident, was broader than the cork. The vascular cylinder in *F. multiflora*, in the central portion of the root, has a ring-shaped cambium, with fewer vessels in the xylem and a few wood fibers noted to surround the vessels (Fig. 1C, D).

Cellular ultrastructure of *Fallopia multiflora* var. *angulata* differed in that the vascular bundle fibers occurred in the outer part of the cortex, and many more abnormal vascular bundles appeared to be scattered in the cortex. Also, pericycle fibers were grouped in bundles in *F. multiflora* var. *angulata*, with wood fibers surrounding the vessels (Fig. 1E, F).

Discussion

Based on our field observations and an earlier study (Liu, 1991), significant morphological differ-

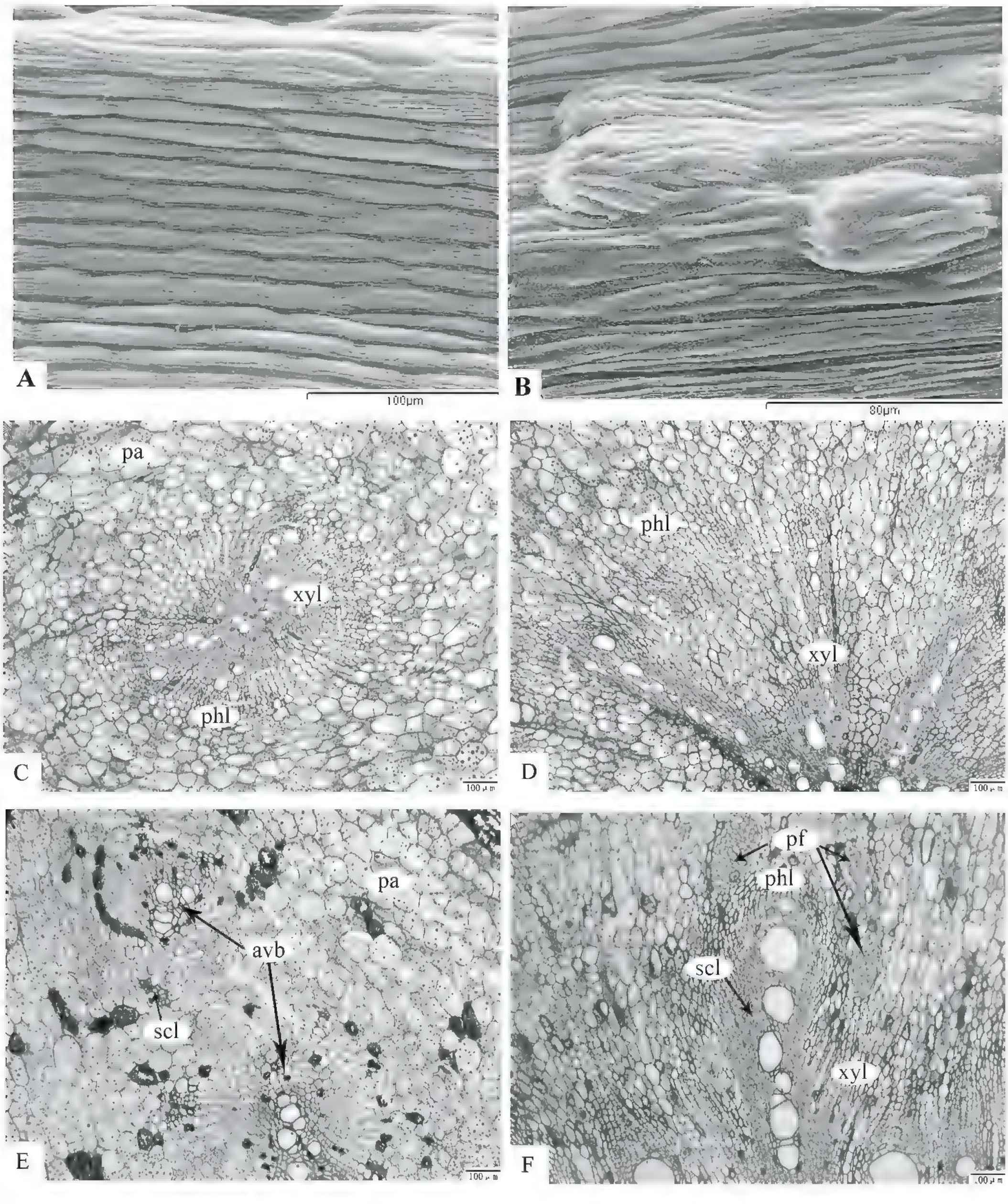

Figure 1. A, B. SEM micrographs of plant stems showing cuticular ornamentation. —A. *Fallopia multiflora* (Thunb.) Haraldson, *H. J. Yan Y05JG* sample from Deqing, Guangdong. —B. *Fallopia multiflora* var. *angulata* (S. Y. Liu) H. J. Yan, Z. J. Fang & Shi Xiao Yu, *S. Y. Liu Y05TY* from Tiangyang, Guangxi. C–F. Light micrographs of root tuber transverse sections. C, D. *Fallopia multiflora* (Thunb.) Haraldson, *H. J. Yan Y05JG* sample from Deqing, Guangdong. —C. Cortex showing abnormal vascular bundles. —D. Normal vascular tissue. E, F. *Fallopia multiflora* var. *angulata* (S. Y. Liu) H. J. Yan, Z. J. Fang & Shi Xiao Yu, *S. Y. Liu Y05TY* from Tiangyang, Guangxi. —E. Cortex showing abnormal vascular bundles. —F. Normal vascular tissue. Abbreviations: avb, abnormal vascular bundles; pa, parenchyma; pf, pericycle fibers; phl, phloem; scl, sclerenchymatous fibers; xyl, xylem.

ences exist between *Fallopia multiflora* var. *angulata* and the typical variety of *F. multiflora*. The former has many more cortical fibers in the root tubers, including pericycle fibers and wood fibers, as well as abnormal vascular strands evident in transverse sections. These characters have remained stable even when the cultivated samples were transplanted for more than 10 years (these are maintained at Guangxi

Traditional Chinese Medical University and Guangdong Pharmaceutical University).

Crude extracts from the roots of *Fallopia multiflora* contain phospholipids, anthraquinones, and bianthraquinonyl glucosides, and these compounds exhibit prominent effects on many clinical therapies, particularly in cardiovascular diseases (Chang, 2000; Chan et al., 2002). We have examined the nature and concentration of 2,3,5,4′-tetrahydroxystilbene-2-O-β-D-glucoside and anthraquinones by high-performance liquid chromatography (Fu et al., 2006; Yan et al., 2007). The content of 2,3,5,4′-tetrahydroxystilbene-2-O-β-D-glucoside from samples of variety *angulatum* collected from Tianyang were only 0.0688%, much lower than 1% (a minimal effective level established by the China Pharmacopoeia Committee [2005]). The content of emodin physcion from these samples was also very low, with very little chrysophanol and rhein detected. The levels of these compounds from *F. multiflora* var. *angulata* were significantly lower than those sampled from *F. multiflora*.

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New Species and Notes on *Begonia* (Begoniaceae) from Middle America, I

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ABSTRACT. Four new species for the Begoniaceae, *Begonia campanensis* Burt-Utley & Utley and *B. fortunensis* Burt-Utley & Utley from Panama; *B. matudae* Burt-Utley & Utley from Chiapas, Mexico; and *B. makrinii* Burt-Utley & Utley from Oaxaca, Mexico, are described and illustrated. *Begonia mucronistipula* C. DC. from Panama is evaluated and synonymized with *B. davidsoniae* Standl. ex L. B. Sm. & B. G. Schub. and *B. brevicyma* C. DC.

RESUMEN. *Begonia campanensis* Burt-Utley & Utley y *B. fortunensis* Burt-Utley & Utley de Panamá, así como *B. matudae* Burt-Utley & Utley de Chiapas y *B. makrinii* Burt-Utley & Utley de Oaxaca, México se describen como nuevo. Se ilustran y evalúa *B. mucronistipula* C. DC. de Panamá, lo que resulta en la sinonimia de *B. davidsoniae* Standl. ex L. B. Sm. & B. G. Schub. y *B. brevicyma* C. DC. con ella.

Key words: *Begonia*, Begoniaceae, Chiapas, IUCN Red List, Mexico, Oaxaca, Panama.

The genus *Begonia* L. is represented in the Neotropics by 600 or more species that are distributed from northern Mexico in the states of Chihuahua, Sinaloa, Nuevo León, and Tamaulipas to southern South America. In Mexico and Central America, there are approximately 160 *Begonia* species, of which 106 occur in Mexico (81 endemic spp.), and, in contrast, only 80 species are reported from all of Central America (46 endemic spp.). Moreover, only a few widely distributed taxa (five spp.) range from Mexico into South America, but several others (five spp.) are primarily South American species at the northernmost extensions of their ranges, occurring in Costa Rica and Panama (Burt-Utley, pers. obs.). Within Mexico and Central America, *Begonia* occupies a diversity of habitats from cloud forests and wet forests to seasonally dry forests and thorn-scrub vegetation at elevations from sea level to over 3300 m. Almost one third of the species in Mexico occur in seasonally dry environments, developing annually from underground tubers, and are most abundant in western Mexico. In *Flora Novo-Galiciana*, Volume 3, 19 of the 25 *Begonia* species treated are tuberous (Burt-Utley & McVaugh, 2001), representing over half of the tuberous species in Mexico (37 spp.) (Burt-Utley, pers. obs.). Unlike Mexico, only five tuberous species are reported from Central America and only two of these are endemic. In both Mexico and Central America, many *Begonia* species have limited distributions and occur in very local populations, potentially resulting from poor seed dispersal because the majority of species have capsules and seeds that lack apparent adaptations for dispersal (Burt-Utley, 1985). Based on morphological characters, there are two of at least 16 groups or sections that appear to be phenetically and geographically cohesive units, representing over half of the *Begonia* species in Mexico and Central America (92 spp.), section *Gireoudia* (Klotzsch) A. DC. (64 spp.) (Burt-Utley & Utley, 1990), and section *Weilbachia* (Klotzsch & Oerst.) A. DC. (25 spp.) (Burt-Utley & Utley, 1999). Within the area delimited by the *Flora Mesoamericana*, there are

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currently 102 *Begonia* species known (Burt-Utley, pers. obs.), most of which occur in evergreen forests. The majority of these taxa are rhizomatous (58 spp.) and have staminate and pistillate flowers with two sepals, while lacking an inner perianth series of petals (55 spp.). Many of these species (44 spp.) have phenetic characters consistent with section *Gireoudia* (Burt-Utley, pers. obs.).

I. Begonia sect. **Gireoudia** (Klotzsch) A. DC., Ann Sci. Nat., Bot. sér. 4: 11. TYPE: *Begonia plebeja* Liebm. (lectotype, designated by Burt-Utley [1985: 33]).

The following four species are assigned to this section because of phenetic characters, including their asymmetric, palmately nerved leaf blades, staminate and pistillate flowers with a perianth comprised of two sepals, and trilocular ovaries with bipartite placentae (Burt-Utley, 1985): *Begonia campanensis*, *B. fortunensis*, *B. makrinii*, and *B. matudae*. Morphological information used for comparisons with two of the new species is taken from Burt-Utley (1985).

1. Begonia campanensis Burt-Utley & Utley, sp. nov. TYPE: Panama. Panamá: Cerro Campana, 2400–2600 ft., 21 Feb. 1987, *J. Utley & K. Utley 7728* (holotype, USF; isotypes, CAS, DUKE, GH, MEXU, MO, NY, PMA, US). Figure 1.

Petioli trichomatibus 1 6 mm longis sparsim vel dense lanati. Stamina (57 ad)68 ad 95; antherae 0.6 1.1 mm longae; stigmata bicornuta. Capsulae 5.5 8.5 mm longae; alae inaequales, ala primaria anguste oblongo-elliptica 15 26 × 5.5 7.5(−8.5) mm.

Rhizomatous herbs 0.4–1 m tall in flower; rhizomes sprawling to erect, frequently rooting at the nodes; internodes most commonly elongate, (0.4–)1.2–2.5(−3.7) cm, 5–13 mm diam., sparingly tomentose. Stipules deciduous, chartaceous, ovate, 15–26 × 12–18 mm, marginally entire, glabrous to minutely glandular or very rarely pilose, keeled, with the keel fimbriate-laciniate, cystospheres present; petioles (11.5–)18–36 cm, sparingly to densely tomentose-lanate with trichomes 1–6 mm; leaf blades oblique, asymmetrically broadly obovate to ovate, elliptic or suborbicular, (10.5–)12–20 × (7.6–)8.4–16.1 cm, basally deeply cordate, apically abruptly short acuminate, marginally ciliate, dentate and usually cuspidate with 1 to 2 cusps distally, above glabrous, below moderately to densely tomentose only on major nerves, cystospheres evident; (12 to)13 to 15(to 16)-palmatinerved. Inflorescences greatly exceeding the foliage, symmetrically to asymmetrically cymose, branches of uppermost nodes reduced in length, ca. 40 flowers or more; peduncles 36.5–70 cm, sparingly pilose with age with trichomes to 2 mm; bracts usually deciduous, the lowermost convolute, navicular, symmetrically to asymmetrically broadly elliptic to ovate or obovate, 22–40 × 19–36 mm, apically apiculate to truncate, marginally entire, glabrous to sparingly glandular and pilose with trichomes to 2.5 mm. Staminate flowers with pedicels 8–14(−38) mm, glabrous to sparingly pilose, cystospheres present; sepals 2, broadly ovate to broadly transversely elliptic or suborbicular, 7–13 × 8–15 mm, glabrous to sparingly pilose, minutely glandular, cystospheres evident, white; petals 2, oblanceolate, 5–8(−11) × (2–)3.5–5(−6) mm, white to pale pink; stamens (57 to)68 to 95; filaments 0.4–1.2 mm on a very low torus; anthers elliptic to narrowly obovate, 0.6–1.1 mm. Pistillate flowers with pedicels (4–)6–13 mm; bracteoles wanting; sepals 2, broadly transversely elliptic to suborbicular, 6–12 × (6.5–)8–13 mm; petals 1 or occasionally wanting, oblanceolate, 5–8 × 2–4.5 mm, white to pale pink; ovaries trilocular with bipartite placentae, (2.5–)3.5–6 mm, glabrous throughout or sparingly pilose basally, cystospheres abundant; styles 3, 1–1.5 mm, connate to 1/2 their length; stigmas bicornute. Capsules with pedicels 8–17 mm; bodies 5.5–8.5 mm; locule chambers externally broadly obovate to elliptic or suborbicular, 4.5–7 × 4.5–6 mm; wings 3, unequal, the largest wing oblong-elliptic, 15–26 × 5.5–7.5(−8.5) mm, the second one asymmetrically triangular, 3.5–5 × 5–7 mm, the third marginiform.

Distribution and habitat. *Begonia campanensis* is known from the cloud forests of Cerro Campana and the vicinity of El Valle de Antón where it occurs at elevations between 730 and 1000 m. In the type locality, now a national park and protected area, it is locally abundant.

IUCN Red List category. *Begonia campanensis* is assessed here as Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001). This species does not appear to be widely distributed in Panama, but its occurrence in Parque Nacional Cerro Campana affords it an important level of protection that it would otherwise not have.

Etymology. The specific epithet *campanensis* refers to Cerro Campana where this species most commonly has been collected.

Discussion. *Begonia campanensis* is characterized by its sprawling to erect rhizomes, petioles

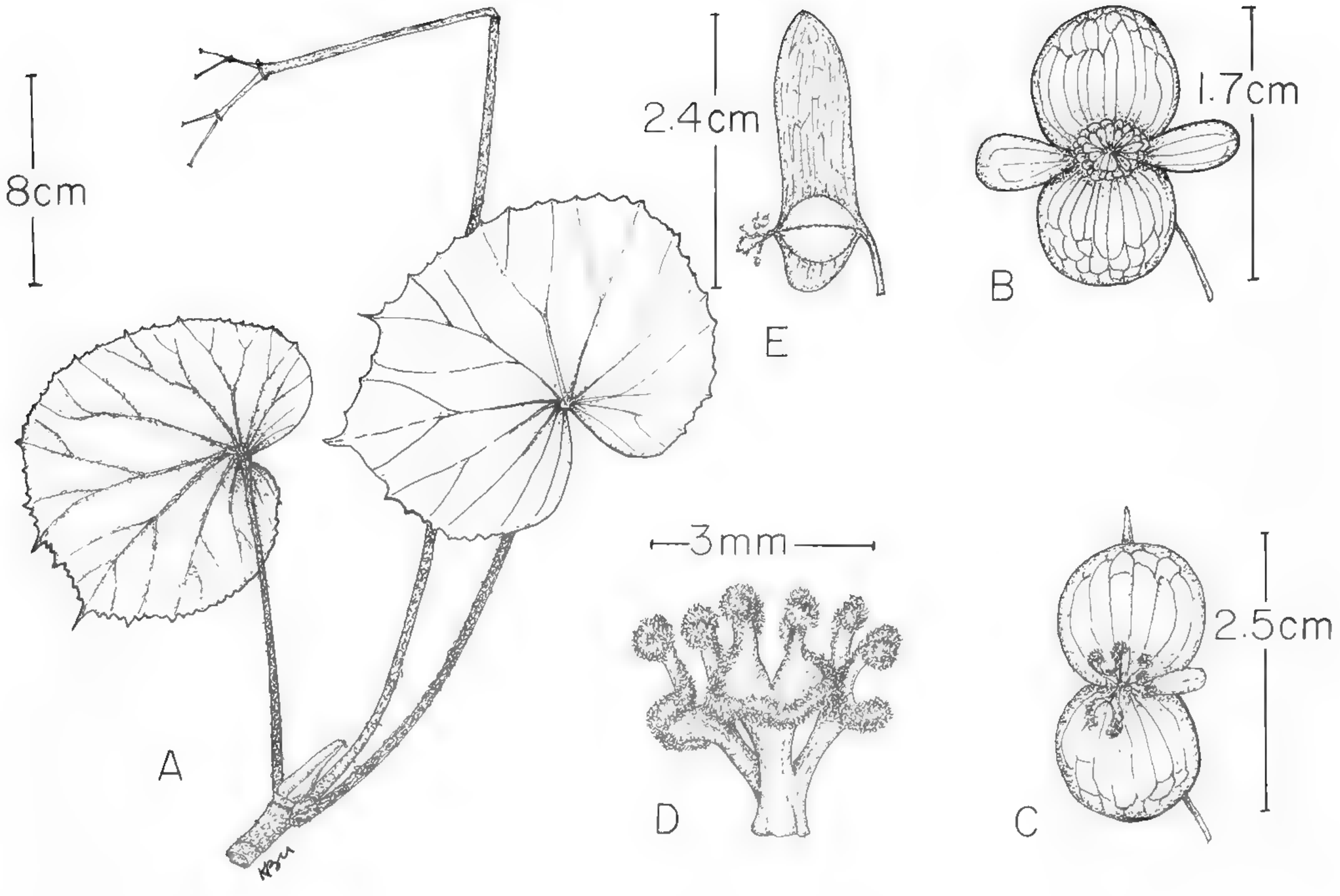

Figure 1. *Begonia campanensis* Burt-Utley & Utley. —A. Habit. —B. Staminate flower. —C. Pistillate flower. —D. Stigmas. —E. Capsule. Drawn from the holotype *J. Utley & K. Utley 7728* (USF).

sparingly to densely lanate, and its staminate and pistillate flowers with an inner perianth series. This species is tentatively placed in section *Gireoudia* because it appears most closely related to another Panamanian endemic, *B. garagarana* C. DC. in section *Gireoudia*, with which it shares its generally elongate rhizome internodes, a similar leaf form, large navicular bracts, flowers with an inner perianth series, numerous stamens, and similar capsules with elongate dorsal wings, but small asymmetrically triangular to marginiform lateral wings (Burt-Utley, 1985). *Begonia campanensis* can be distinguished readily from *B. garagarana* by numerous other vegetative and floral characters, including its tomentose to lanate petioles versus glabrate petioles, longer trichomes (1–6 mm vs. 0.1–1 mm), persistent stipules, larger bracts (22–40 × 19–36 mm vs. 14–19 × 10–16 mm), more numerous stamens ([57–]68 to 95 vs. 30 to 46), shorter anthers (0.6–1.1 mm vs. 2–2.8 mm), shorter capsular pedicels (8–17 mm vs. 17–30 mm), and more narrow primary wings (5.5–7.5[–8.5] mm vs. [7–]11–15 mm).

Paratypes. PANAMA. **Coclé:** hills N of El Valle de Antón, vic. of La Mesa, 21 Jan. 1941, *P. Allen 2341* (F); divide SW of La Mesa at end of logging rd., 80°5′W, 8°35′N, 26 Dec. 1982, *B. Stein & C. Hamilton 975* (MO, USF). **Panamá:** Cerro Campana, near tower, 30 Mar. 1977, *J. Folsom, W. D'Arcy & L. Skog 2292* (MO, USF); 11 Mar. 1973, *R. Liesner 598* (CAS, DUKE, F, MEXU, MO [2], NY, US, USF); 29 Mar. 1977, *D'Arcy 11139* (MO, USF); above Su Lin Motel, 25 Mar. 1969, *D. M. Porter et al. 4211* (F, MO [2], UC); *D. M. Porter et al. 4287* (MO); low cloud forest near summit, 31 Dec. 1957, *L. B. Smith & S. Smith 3382* (F, MO); Parque Nacional Cerro Campana, 2 km N of hwy. 707, 79°55′W, 8°42′N, 850 m, 1 Jan. 1983, *Stein & Hamilton 1129* (MO).

2. Begonia fortunensis Burt-Utley & Utley, sp. nov. TYPE: Panama. Chiriquí: along trail ca. 1 mi. S of the Centro de Operaciones, toward refugio, upstream from suspension bridge over Río Hornito, 8°45′N, 82°14.5′W, 1100 m, 26 Feb. 1987, *J. Utley & K. Utley 7788* (holotype, USF; isotypes, C, CAS, DUKE, F, GH, MEXU, MICH, MO, NY, PMA, US). Figure 2.

Rhizomata repentia, internodiis elongatis villoso-squamosis vel squamosis. Stipulae persistentes cucullatae; petiolus indumento usque ad 3.5 mm longo dense squamosus vel villoso-squamosus; lamina foliaris lobata. Inflorescentiae 2- ad 4-dichotomae usque quadrichotomae. Stamina (6 ad)9 ad 14(ad 18); stigmata bicornuta.

Herbaceous perennials; rhizomes repent; internodes short to elongate, 0.6–4.5 cm, 0.3–0.7 cm diam., villous-squamose to squamose, with lacerate scales to 3 mm. Stipules persistent, distally cucullate,

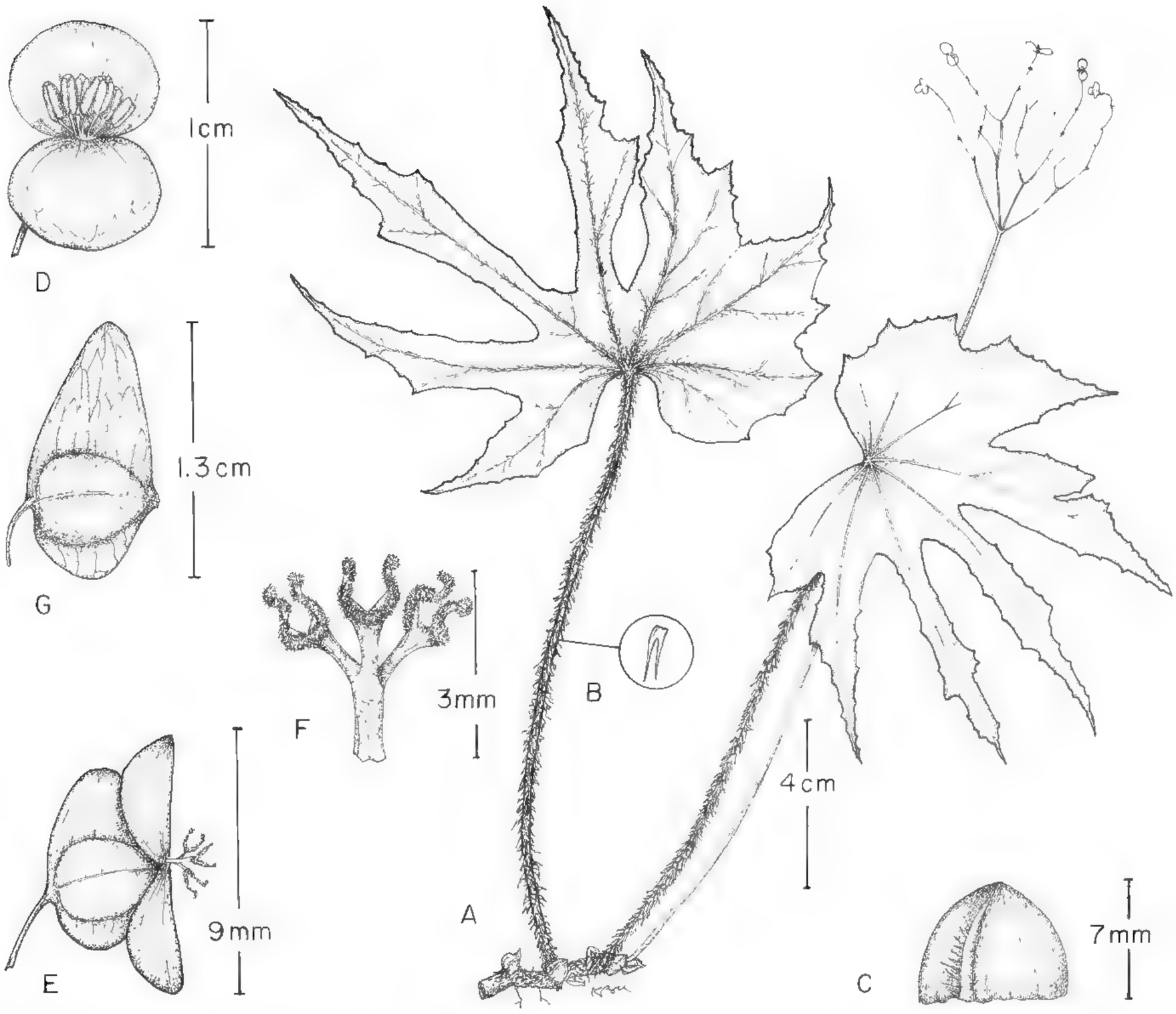

Figure 2. *Begonia fortunensis* Burt-Utley & Utley. —A. Habit. —B. Petiolar scale. —C. Stipule. —D. Staminate flower. —E. Pistillate flower. —F. Stigmas. —G. Capsule. Drawn from the holotype *J. Utley & K. Utley 7788* (USF).

asymmetrically very broadly ovate to hemiorbicular, 5–11 × 6–9 mm, marginally entire, densely villous-squamose, keeled, with the keel only villous; petioles (8–)11–21(–32) cm, densely squamose or villous-squamose with villi and lacerate scales to 3.5 mm, cystospheres evident; leaf blades asymmetric, rarely symmetric, straight to oblique, transversely elliptic to obovate in outline, (5–)7–13.5 × (6.5–)10.5–20 cm, basally cordate, apically with no distinct apex, marginally deeply sinuately to palmately lobed with (3 or)4 to 8 lobes, usually 2 to 4 lobes incised 2/3 the length of the blade, eciliate and irregularly dentate to serrate, glabrous above, villous below only on major nerves; 9 to 11(to 12)-palmatinerved. Inflorescences generally exceeding the foliage, symmetric to weakly asymmetric, (2 to)3 to 4 radiate at the lowermost node, but only 2-branched at upper nodes, 40 flowers or more; peduncles 17.7–46 cm, glabrous or rarely very sparingly villous; bracts deciduous, at the lowermost node 2 to 4, very narrowly ovate to oblong or obovate, 1.5–4 mm × 1–2.5 mm, glabrous. Staminate flowers with pedicels 5.5–8.5(–10) mm, glabrous to minutely glandular; sepals 2, broadly obovate to transversely elliptic, 4–6.5 × 4.5–8 mm, glabrous; petals wanting; stamens (6 to)9 to 14(to 18); filaments 0.3–1.1 mm, free or on a low torus; anthers narrowly elliptic to obovoid, 0.9–2 mm. Pistillate flowers with pedicels 4–9.5 mm; bracteoles wanting; sepals 2, broadly obovate to transversely elliptic, 4–7 × 4.5–7.5 mm, glabrous; petals wanting; ovary trilocular with bipartite placentae, 3.5–4.5(–5) mm, glabrous or rarely basally sparsely hirtellous; styles 3, 1.5–2 mm, connate to 1/2 their length; stigmas bicornute. Capsules with pedicels (8–)10–13 mm; bodies 6–7 mm; locule chambers externally appearing ovate to oblong, 5–5.5 × 4–5 mm; wings 3, unequal, the largest wing asymmetrically ovate to ovate-triangular, 7.5–9.5 × 6.5–7 mm, the second and third ones subequal to each other, elliptic to asymmetrically triangular, 3.5–4.5 × 5–5.5 mm.

Distribution and habitat. *Begonia fortunensis* is known only from Chiriquí Province in Panama, where it is locally common on wet, evergreen forested slopes above streams and rivers between 1400 and 1900 m.

IUCN Red List category. *Begonia fortunensis* is assessed here as Data Deficient (DD) according to

IUCN Red List criteria (IUCN, 2001). *Begonia fortunensis* appears to have a limited distribution in Panama and occurs in isolated, small populations. The species is afforded a level of protection because it is found in an area protected by the Fortuna Dam.

Etymology. The specific epithet *fortunensis* refers to the watershed of the Fortuna Dam site where the type was collected.

Discussion. Palmately lobed leaves, squamose to villous-squamose petioles, small capsules, and an unusual inflorescence form with more than two branches at lower inflorescence nodes distinguish *Begonia fortunensis* from other Mesoamerican *Begonia*. Only one other species in section *Gireoudia*, *B. quaternata* L. B. Sm. & B. G. Schub. from western Panama and eastern Costa Rica, has lower inflorescence nodes that regularly have more than two branches. Although these species share similar inflorescence branching patterns, squamose to villous-squamose induments, and cucullate to navicular stipules, they can be distinguished from each other readily by both vegetative and floral characters. In all specimens examined, leaf blades of *B. fortunensis* have conspicuous, deeply sinuate lobing, whereas those of *B. quaternata* are unlobed and only irregularly denticulate to dentate at ends of major nerves. Moreover, the generally smaller, persistent stipules observed on rhizomes of *B. fortunensis* differ from the larger, broader fugacious to caducous stipules of *B. quaternata* (5–11 × 6–9 vs. 9–13[–17] × 9–15 mm). Although both species have flowers with sepals of similar size, staminate flowers of *B. fortunensis* generally have fewer stamens than those of *B. quaternata* ([6–]9–18 vs. [11–]16–27[–30]), and their pistillate flowers have bicornute stigmas, which is in contrast to the broadly lunate stigmas of *B. quaternata* that occasionally have ends just beginning to spiral when dry (Burt-Utley, 1985).

Paratypes. PANAMA. **Chiriquí:** vic. of Los Planes de Hornito, along rd. to Fortuna Dam, N of Gualaca on Río Chiriquí, 2–3 km E of Finca Linares, 28 Nov. 1979, *T. Antonio 2866* (MO); E of Boquete on Cerro Azul near Quebrada Jaramillo, 11 Aug. 1974, *T. B. Croat 26787* (MO, USF); vic. of Planes de Hornito beyond Gualaca, ca. 23 km E of Finca Linares, 28 Nov. 1979, 1400 1900 m, *Croat 48844* (USF); vic. of Fortuna Dam, along trail below hwy. and across valley of Río Hornito, 8°45′N 82°15′W, 24 Jan. 1988, *G. McPherson 11984* (MO).

3. Begonia makrinii Morton ex Burt-Utley & Utley, sp. nov. TYPE: Mexico. Oaxaca: vic. of Cafetal Concordia, 400–650 m, 15 Apr. 1933, *C. V. Morton & E. Makrinius 2701* (holotype, US; isotype, F). Figure 3.

Rhizomata repentia, internodiis crassis 0.8 2.2 cm diam. Stipulae persistentes late ovatae 17 30 × (8)21 24 mm; petiolus trichomatibus (3)5 6 mm longis lanatus. Stamina 10 ad 13; stigmata lunata. Capsulae 6.5 9.5 mm longae; alae subaequales, ala primaria asymmetrice triangulari latiore quam longiore 5 7 × 6.5 8.5 mm.

Herbaceous perennials; rhizomes repent; internodes short and stout, 4–8 mm, (0.8–)1–2.2 cm diam., densely lanate in internodes with branching whiplash trichomes 4–9 mm and rings of narrow scales surrounding petiole scars. Stipules persistent, chartaceous, broadly ovate, 17–30 × (8–)21–24 mm, marginally entire, glabrous, strongly keeled, with the keel fimbriate-laciniate; petioles 4.8 cm or more, lanate with whiplash trichomes (3–)5–6 mm; leaf blades oblique, asymmetrically ovate to elliptic, 7.3–9 × 5–6.5 cm when not fully expanded, basally cordate, apically acuminate, marginally dentate to doubly dentate at ends of major nerves, ciliate and denticulate to irregularly dentate, pilose above with trichomes to 2 mm, pilose below with trichomes to 5 mm; 9-palmatinerved. Inflorescences shorter than to potentially exceeding the foliage, strongly asymmetric to unilateral, cymose, ca. 40 flowers or more; peduncles 7–19.4 cm, moderately to densely lanate with trichomes to 7 mm; bracts persistent, the lowermost broadly elliptic with one of the pairs appearing bilobed or trilobed distally, 5–7 × 3–6 mm, apically apiculate, marginally glandular-ciliate-denticulate distally, glandular within and without. Staminate flowers with pedicels 6.5–8.5 mm, minutely glandular; sepals very broadly transversely elliptic to suborbicular, 6–6.5 × 6–7.5 mm, glandular within and without, white; petals wanting; stamens 10 to 13; filaments 0.5–1 mm, borne on a low torus; anthers oblong to narrowly obovate, 1.3–1.5 mm. Pistillate flowers with pedicels 8–11 mm post-anthesis, bracteoles wanting; sepals 2, persistent on maturing capsules, broadly oblong-elliptic to broadly transversely elliptic, 5.5–9 × 5.5–8.5 mm, sparingly glandular within and without, white; petals wanting; ovary trilocular with bipartite placentae, 6–7.5 mm post-anthesis, minutely glandular; styles 3, 1.5–2 mm, fused to 1/2 their length; stigmas lunate. Capsules with pedicels (7.5–)9–12(–17) mm, conspicuously glandular; bodies 6.5–9.5 mm; locule chambers appearing elliptic, 6–7.5 × 4–4.5 mm; wings subequal, the largest one asymmetrically triangular, 5–7 × 6.5–8.5 mm, remaining wings lunate to triangular, 3.5–5 × 6.5–9 mm.

Distribution and habitat. Begonia makrinii is known only from the type locality in the Sierra Madre del Sur at elevations between 400 and 650 m in the vicinity of Cafetal Concordia on Cerro Concordia

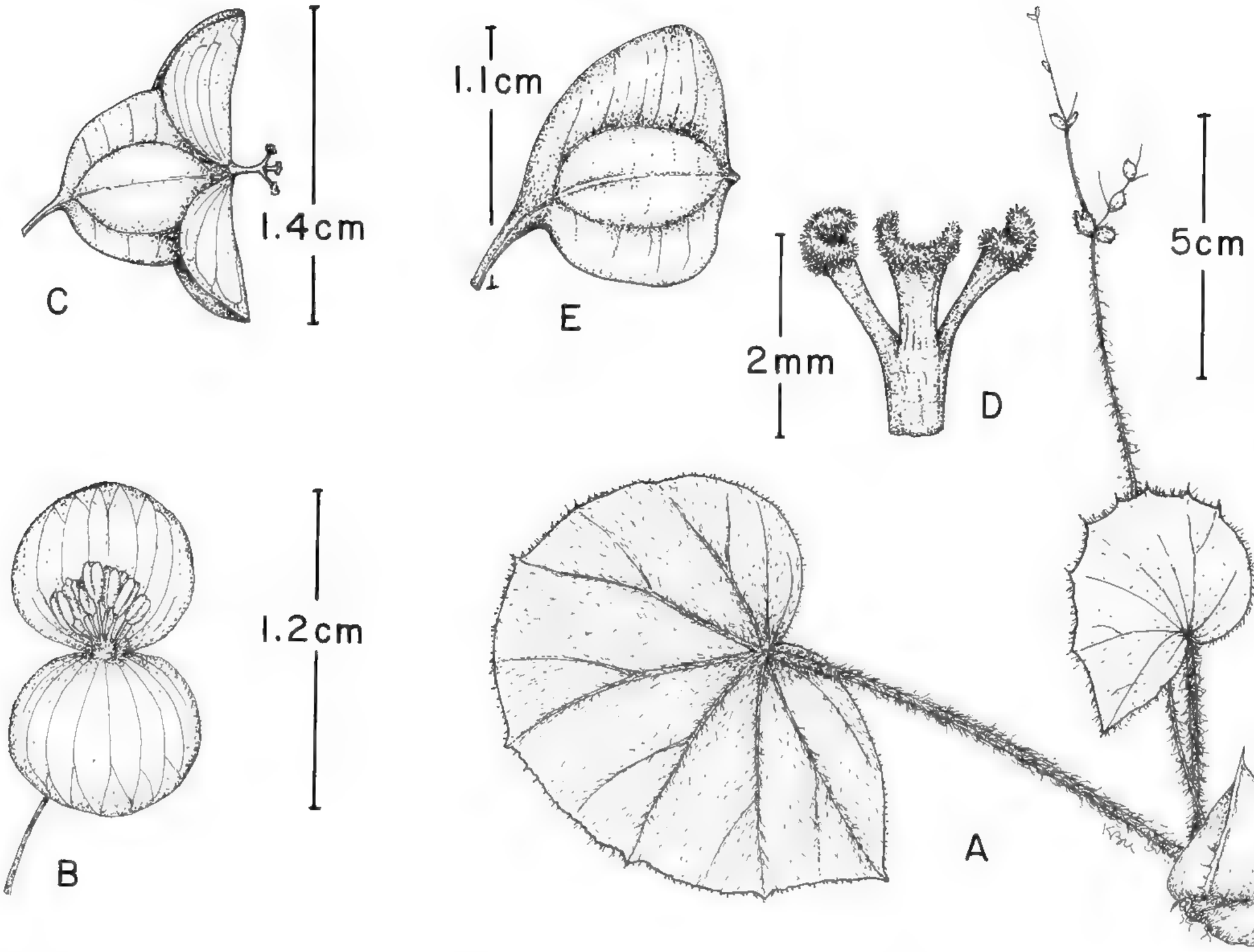

Figure 3. *Begonia makrinii* Morton ex Burt-Utley & Utley. —A. Habit. —B. Staminate flower. —C. Pistillate flower. —D. Lunate stigmas. —E. Capsule with remains of perianth removed. A–E illustrated from the holotype *C. V. Morton & E. Makrinius 2701* (US).

(Cerro Espino). Although this area was visited by botanists in the early 20th century, few have collected there since Morton and Makrinius.

IUCN Red List category. *Begonia makrinii* is assessed here as Data Deficient (DD) according to IUCN Red List criteria (IUCN, 2001). The general region where the type of *B. makrinii* was collected is an important area for the cultivation of coffee in southern Oaxaca. Until other collections of this rare species are found, it is impossible to make any meaningful judgments about risks to the survival of this species.

Etymology. *Begonia makrinii* is named in honor of Emil Makrinius, who collected this species while assisting C. V. Morton in his fieldwork in Mexico when he was ill.

Discussion. *Begonia makrinii* is characterized by a suite of characters, including rhizomes with short, stout internodes, petioles with whiplash trichomes, strongly asymmetric cymose inflorescences, persistent bracts, staminate flowers with few stamens, and capsules with persistent sepals and subequal wings. The whiplash trichomes observed on *B. makrinii* are known from other species in section *Gireoudia* (Burt-Utley, 1985), including *B. hydrocotylifolia* Otto ex Hook. (Fellerer, 1892) and *B. chiapensis* Burt-Utley (Burt-Utley, 1986) but have not been observed in other phenetic groups from Mexico or Central America. Leaf blades on the holotype are not fully expanded and it is likely that specimens with larger leaves and longer petioles than those observed will be encountered. This is supported by C. V. Morton's notation on the holotype that "the leaves get very much larger (fide Makrinius)." *Begonia makrinii* is most similar to *B. hydrocotylifolia* Hook., a Mexican endemic from the barrancas in central Veracruz, in a group of characters including its rhizomatous habit, whiplash trichomes, ciliate bracts, lunate stigmas, and immature capsules with persistent perianths and subequal wings. These species may be separated from each other by their distribution in Mexico, and a number of vegetative and reproductive characters, including *B. makrinii*'s larger stipules (17–30 mm vs. 6–11 mm), longer leaf blades (7.3–9+ cm vs. 3.6–6.2

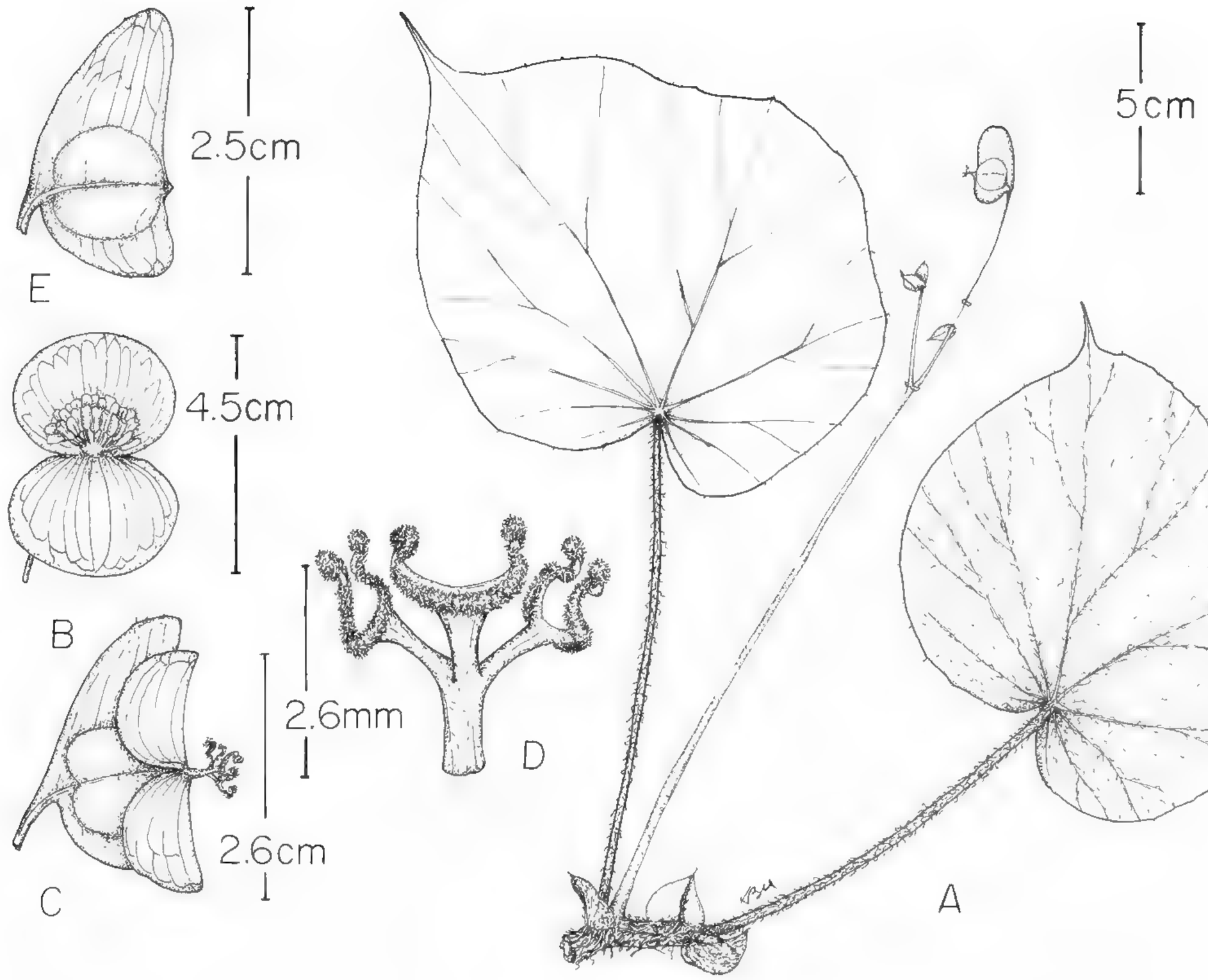

Figure 4. *Begonia matudae* Burt-Utley & Utley. —A. Habit. —B. Staminate flower. —C. Pistillate flower. —D. Stigmas. —E. Capsule. A and B drawn from *E. Matuda 38397* (MEXU); C–E from the holotype *D. E. Breedlove & R. Thorne 30107* (DS).

cm), and smaller capsules (6.5–9.5 mm vs. [8.5–]10–13 mm) (Burt-Utley, pers. obs.).

4. **Begonia matudae** Burt-Utley & Utley, sp. nov. TYPE: Mexico. Chiapas: SE side of Cerro Tres Picos & ridges near summit, 2100–2500 m, 11 Dec. 1972, *D. E. Breedlove & R. Thorne 30107* (holotype, DS). Figure 4.

Rhizomata repentia, internodiis 1 1.5 cm longis dense squamosis. Stipulae persistentes; petiolus trichomatibus 7 mm longis dense pilosus. Stamina 30 vel 31; stigmata bicornuta. Capsulae 9 13.5 mm longae; alae inaequales.

Herbaceous perennials; rhizomes repent; internodes 1–1.5 cm, 5–8 mm diam., densely squamose with lacerate scales to 8 mm. Stipules persistent, cartilaginous, asymmetrically broadly ovate, 13–20 × 13–17 mm, marginally entire, villous throughout, strongly keeled, with the keel fimbriate; petioles 11–20 cm, densely pilose with villi and occasional narrow scales to 7 mm; leaf blades oblique, asymmetrically ovate to elliptic, 14.5–20 × 10–14.5 cm, basally cordate, apically attenuate-acuminate, marginally dentate to undulate at ends of major nerves, ciliate and denticulate to irregularly dentate, glabrous to very sparingly pilose only near the blade petiole junction, pilose throughout below with trichomes 4–5 mm; 10-palmatinerved. Inflorescences shorter than to barely exceeding the foliage, moderately asymmetrically cymose, ± 10 to 20 flowers; peduncles 11.5–26 cm, sparingly villous; bracts deciduous to persistent, the lowermost broadly ovate, 4.5–7 × 4–6 mm, marginally entire, glabrous to sparingly villous distally. Staminate flowers with the pedicels unknown, sepals 2, transversely elliptic, 15–18 × 20–23 mm, glabrous; petals wanting; stamens 30 or 31; filaments 1.5–2 mm, borne on a low torus; anthers oblong to narrowly obovate, 1.8–2.5 mm. Pistillate flowers with pedicels 16–22 mm, bracteoles wanting; sepals 2, transversely elliptic, 11–13 × 15–19 mm, glabrous, pink; petals wanting; ovary 9–11 mm, trilocular to quadrilocular with bipartite placentae, glabrous, pink; styles 3, occasionally one bearing an additional stigmatic surface, 2 mm, connate to 1/2 their length; stigmas bicornute. Capsules with pedicels (18–)21–30 mm; bodies 9–13.5 mm; locule chambers externally appearing transversely broadly elliptic or suborbicular, 7–11.5

× 8–11 mm; wings 3 or 4, unequal, the largest wing straight to subfalcate and oblong to ovate, (11–)14–18 × (7–)10–14.5 mm, marginally entire to denticulate and sparingly ciliate distally, if a fourth wing present, then that wing subequal to the first, remaining wings marginiform.

Distribution and habitat. *Begonia matudae* is known only from elevations between 2100 and 2500 m in montane rainforests, evergreen cloud forests, and elfin forests with *Drimys* J. R. Forst. & G. Forst., *Quercus* L., *Ostrya* Scop., *Liquidambar* L., *Styrax* L., and *Ilex* L. in the Sierra Madre de Chiapas in southern Chiapas.

IUCN Red List category. *Begonia matudae* is assessed here as Data Deficient (DD). This species has only been collected twice from an area of Chiapas that has not been well collected. More collections are necessary to adequately evaluate the species and determine its IUCN category.

Etymology. It is a pleasure to name this species in honor of the late Dr. Eizi Matuda (1894–1978) who made many significant and interesting *Begonia* collections in Chiapas and elsewhere in Mexico.

Discussion. *Begonia matudae* is an attractive species with elongate internodes, densely pilose petioles with villi and occasional narrow scales, large flowers, bicornute stigmas, and large capsules. In its indument, general leaf form, and stigmatic structure, *B. matudae* appears most similar to *B. chiapensis* (Burt-Utley, 1986). The longer petiolar hairs (7 mm vs. 2 mm), larger stipules (1.3–2 cm vs. 0.5–1.5 cm), larger sepals (♂: 15–18 × 20–23 mm vs. 5.5–8 × 7–11 mm), larger anthers (1.8–2.5 mm vs. 1–1.3 mm), and capsules (9–13.5 mm vs. 8–9 mm) of *B. matudae* effectively separate these species. Capsules on the paratype *E. Matuda 38397* are unusual in being occasionally quadrilocular and having four wings. Although these specimens had ovaries with three styles, one of the styles bore two stigmas. In other characters the Matuda collection was indistinguishable from the holotype. Although species in section *Gireoudia* characteristically have trilocular ovaries, capsules with an additional locule and wing are encountered (Burt-Utley, pers. obs.) and could represent occasional developmental aberrations. More collections of *B. matudae* are needed to evaluate the significance of variation in capsular characters observed.

Paratypes. MEXICO. **Chiapas:** Ojo de Agua, Paxital, 8 Jan. 1972, *E. Matuda 38397* (MEXU).

Taxonomic Notes

Begonia mucronistipula C. DC., Smithsonian. Misc. Collect. 69: 3. 1919. TYPE: Panama. Chiriquí: betw. Río Ladrillo & Los Siguas Camp, S slope of Cerro de la Horqueta, 1200–1700 m, 17–19 Mar. 1911, *H. Pittier 3172* (holotype, US; isotype, US).

Begonia brevicyma C. DC., Smithsonian Misc. Collect. 69: 3. 1919. TYPE: Panama. Chiriquí: humid forest around Los Siguas Camp, S slope of Cerro de la Horqueta, 1700 m, 17 19 Mar. 1911, *W. R. Maxon 5417* (holotype, US).

Begonia davidsoniae Standl. ex L. B. Sm. & B. G. Schub., J. Wash. Acad. Sci. 40: 242. 1950, as "*davidsonae*." TYPE: Panama. Chiriquí: Bajo Chorro, Boquete Distr., 6000 ft., 5 Jan. 1938, *M. E. Davidson 38* (holotype, MO; isotypes, F, US).

Begonia mucronistipula and *B. brevicyma* were both discovered on the southern slope of Cerro Horqueta near the Los Siguas Camp during a collecting trip March 17–19, 1911. In Casimir de Candolle's description of *B. mucronistipula* (1919), staminate flowers were characterized as having free stamens, while those of *B. brevicyma* had stamens inserted on a raised torus. With respect to stamen insertion, both taxa have stamens inserted on a raised torus and cannot be distinguished from each other by using this character. Moreover, pistillate flowers of *B. mucronistipula* were described as 3-lobed, but were unknown for *B. brevicyma*. However, Lyman Smith noted on the holotype of this latter taxon that pistillate flowers had an inner perianth series of two "tepals" or petals. *Begonia davidsoniae* was described and distinguished from both *B. mucronistipula* and *B. brevicyma* by its two inner petals (instead of none or one) and its bracteoles (Smith & Schubert, 1950). Material from the holotype of this taxon (*M. E. Davidson 38*, MO) had an immature pistillate flower with two sepals and two petals, as well as a single rudimentary bracteole subtending only one of the immature pistillate flowers observed. Both *B. mucronistipula* and *B. davidsoniae* were distinguished from *B. brevicyma* by staminate petal (tepal) shape when compared with sepal shape by Smith and Schubert (1958) in the *Flora of Panama* and by Smith and Wasshausen (1986) in a key to the Begoniaceae. In *B. brevicyma*, they were characterized as being subsimilar, while those of both *B. mucronistipula* and *B. davidsoniae* were considered to be dissimilar to the sepals. Using this criterion, it is impossible to distinguish these taxa from one another in the key because the inner perianth series or petals are essentially the same size and shape in all three taxa. With respect to petal number on pistillate flowers, the type collection of *B. davidsoniae* (*M. E. Davidson 38*, F, MO, US) revealed pistillate flowers

with one or two petals, like those of either *B. mucronistipula* or *B. brevicyma*. Although both *B. brevicyma* and *B. davidsoniae* were tentatively placed in *Weilbachia*, a section characterized by bilocular ovaries, and *B. mucronistipula* was included in section *Gireoudia* (Doorenbos et al., 1998), all three taxa have similar trilocular ovaries. Moreover, vegetatively, these taxa cannot be distinguished from one another and also have characteristic cystoliths that are abundant in ovary and capsule walls, as well as in their bracts and sepals. Considering that it is impossible to distinguish these taxa from one another, both *B. brevicyma* and *B. davidsoniae* herein are considered synonymous with *B. mucronistipula*.

Additional specimens examined. PANAMA. **Chiriquí:** Bajo Chorro-Boquete Distr., *D'Arcy 10106* (MO, USF), *Woodson & Schery 620* (MO); 3.5 mi. NE of Boquete, end of rd. along Río Palo Alto, 17 Nov. 1978, *Hammel 5682* (MO, USF); NW of Boquete, Cerro Horqueta, *Dwyer et al.* (MO); W-facing slopes, open S flank of Cerro Horqueta, *Cochrane et al. 6272* (MO, WIS); SW slopes of Cerro Horqueta ca. 6 km NW of Boquete, *Wilbur et al. 15458* (DUKE); slopes approaching Cerro Horqueta starting ca. 6.6 km N-NE of Cerro Boquete, *Wilbur & Luteyn 19247* (DUKE); end of rd. to Bajo Mono, *Folsom et al. 2256* (MO).

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Transfer of Four Species of *Scabiosa* to *Lomelosia* (Dipsacaceae)

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ABSTRACT. Four species of *Scabiosa* L. are transferred to *Lomelosia* Raf. (Dipsacaceae) to complete the relocation of all scabious taxa with a pitted epicalyx into *Lomelosia*. The new combinations are: *L. deserticola* (Rech. f.) P. Caputo & Del Guacchio, *L. poecilocarpa* (Rech. f.) P. Caputo & Del Guacchio, *L. schimperiana* (Boiss. & Buhse) P. Caputo & Del Guacchio, and *L. transcaspica* (Rech. f.) P. Caputo & Del Guacchio.

Key words: Dipsacaceae, *Lomelosia*, *Scabiosa*.

Scabiosa L., according to its original concept (Linnaeus, 1753), was a broadly comprehensive genus. It included all taxonomic entities later placed in Dipsacaceae by Jussieu (1789) with flat or round, many-flowered capitula. The other two dipsacaceous genera recognized by Linnaeus, i.e., *Dipsacus* L. and *Knautia* L., respectively, included the more or less prickly entities with cylindrical capitula and one single pauci-flowered species (*K. orientalis* L.), which resembled *Lychnis* L. in its gross floral morphology. Later, *Scabiosa* sensu Linnaeus underwent various vicissitudes, mainly restricting its circumscription; taxa were segregated into different genera, and *Scabiosa* was subdivided into infrageneric taxa. Some of these names contributed to distinguish *Scabiosa* from far removed forms. For example, Adanson (1763) segregated the taxa with multiplied, plumose calyx awns into *Pterocephalus* Adans.; Haller (1768) segregated *Succisa* Haller, which has a praemorse rhizome and a 5-lobed epicalyx, while Roemer and Schultes, in their Systema Vegetabilium (1818), distinguished *Cephalaria* Schrad. ex Roem. & Schult. for its multiseriate involucral bracts and awned epicalyx. Additionally, Coulter (1824) gave a much wider circumscription for *Knautia*, and Beck (1893) separated *Succisella* Beck mainly on the basis of its urceolate epicalyx and lack of calyx awns.

Around the same time, various scholars, such as Coulter (1824) and Höck (1891), presented a much more restricted circumscription of the genus *Scabiosa* (including only taxa with an epicalyx distally expanded into a more or less membranous rim or corona), segregating *Trochocephalus* (Mert. & W. D. J. Koch) Opiz (= *Scabiosa* sect. *Trochocephalus* Mert. & W. D. J. Koch, = subgenus *Asterocephalus* (Coult.) Lack & Rech. f.), *Cyrtostemma* (Mert. & W. D. J. Koch) Spach (= *Scabiosa* sect. *Cyrtostemma* Mert. & W. D. J. Koch), *Sclerostemma* Schott ex Roem. & Schult. (= *Scabiosa* sect. *Sclerostemma* Mert. & W. D. J. Koch), and *Spongostemma* (Rchb.) Rchb. (= *Scabiosa* subg. *Spongostemma* Rchb.). By the 20th century, the taxonomic concept of *Scabiosa* included only those forms with more or less radiant capitula, a 5-awned calyx, and an epicalyx with a membranous corona (Ehrendorfer, 1964; Moore, 1976). *Scabiosa* sect. *Trochocephalus* includes taxa with eight pits at the apex of the epicalyx tube; *Scabiosa* sect. *Cyrtostemma* includes taxa with what were interpreted at the time as eight membranous openings (fenestrae) in an otherwise sclerified corona (Mayer and Ehrendorfer [1999] demonstrated that fenestrae are part of the epicalyx tube, not of the corona); and *Scabiosa* sect. *Scabiosa* includes taxa without pits or fenestrae.

After the studies of Verláque (1984, 1985, 1986a, 1986b) and Devesa (1984), which demonstrated independent evolutionary histories for the various sections of *Scabiosa*, Greuter and Raus (1985) designated *Lomelosia* Raf. (with priority over *Trochocephalus*) for the species traditionally belonging to *Scabiosa* sect. *Trochocephalus* and selected *Sixalix* Raf. for those species belonging to *Scabiosa* sect. *Cyrtostemma*. However, their work concerned only circum-mediterranean species.

The generic name *Pseudoscabiosa* Devesa (a replacement name for *Scabiosa* sect. *Asterothrix* Font Quer) was subsequently used (Greuter et al., 1986) for four archaic species traditionally either placed within *Scabiosa* sect. *Trochocephalus* or isolated in section *Asterothrix*. One of these species was later segregated by López Gonzáles (1987) as a new genus *Pterocephalidium* G. López as *P. diandrum* (Lag.) G. López. Later, Soják (1987) transferred several *Scabiosa* taxa from Asia to *Lomelosia*. Finally, Rechinger (1989) and Lack and Rechinger (1991), while describing new species from Iran and adjacent Southwest Asia, did not adopt the nomenclatural changes proposed in Greuter and Raus (1985), and raised *Scabiosa* sect. *Asterocephalus* to subgeneric

status. Moreover, Rechinger (1989) created *Scabiosa* sect. *Olivierianae* Rech. f. to accommodate some annual members of *Scabiosa* subg. *Asterocephalus* with few-flowered capitula (this section was confirmed as monophyletic in a morphological investigation on species of *Lomelosia* by Castro & Caputo, 1999). Finally, on the basis of fruit differentiation and pollen, Mayer and Ehrendorfer (1999) demonstrated quite convincingly that *Lomelosia* is rather distant from the remaining members of *Scabiosa*, whereas *Scabiosa* s. str. and *Sixalix* are sister groups and so close that they hardly deserve separate generic status. Therefore, they proposed to merge *Sixalix* again within *Scabiosa* sect. *Cyrtostemma*. The distance of *Lomelosia* from the other scabious Dipsacaceae, as well as the sister group relationship between *Sixalix* and *Scabiosa*, were confirmed on molecular grounds by Caputo et al. (2004) and Avino et al. (2009), based on four DNA regions from the chloroplast and nucleus. Therefore, *Scabiosa* now encompasses only the eight species located in *Scabiosa* sect. *Cyrtostemma* and ca. 30 in section *Scabiosa* (= *Scabiosa* sect. *Sclerostemma*).

Accordingly, the transfer to *Lomelosia* is here proposed for three scabious taxa described by Rechinger (1989) and Lack and Rechinger (1991) in *Scabiosa* subg. *Asterocephalus*, i.e., *S. deserticola* Rech. f., *S. poecilocarpa* Rech. f., *S. transcaspica* Rech. f., as well as for another eastern *Scabiosa* species present in Iran, *S. schimperiana* Boiss. & Buhse. These four taxa show eight pits at the summit of the epicalyx tube, as indicated by Lack and Rechinger in both the descriptions and illustrations of all four taxa (Lack & Rechinger, 1991); this is a synapomorphic condition for *Lomelosia* (Caputo & Cozzolino, 1994) as well. Such transfer should complete the relocation of all known *Asterocephalus* taxa into *Lomelosia*.

It may be interesting to note alternate taxonomic placements for the transferred names. Jamzad (1993), who keeps a traditional and broad concept of genus *Scabiosa*, regarded *S. deserticola* as a synonym of *S. olivieri* Coult., *S. poecilocarpa* as a synonym of *S. persica* Boiss. var. *rosea* Jamzad, and *S. transcaspica* as a synonym of *S. flavida* Boiss. & Hausskn. On the other hand, Czerepanov (1995) accepted independent species rank for *S. deserticola* and *S. transcaspica*. However, we would like to note that taxonomic concepts employed in dipsacaceous taxa can be quite narrow, as testified by the fragmentation of *Scabiosa* and *Pterocephalus* (López Gonzáles, 1987; Mayer & Ehrendorfer, 2000), and species, especially within the *Scabiosa* group, often rest on small differences (e.g., within the *S. columbaria* L. group).

Lomelosia deserticola (Rech. f.) P. Caputo & Del Guacchio, comb. nov. Basionym: *Scabiosa deserticola* Rech. f., Willdenowia 19(1): 142. 1989. TYPE: "Iraq, Desertum occidentale (Western Desert): in arenosis 2 km E Rutba versus Ramadi, 28.5.1957," *K. H. Rechinger 12806* (holotype, W not seen).

Habitat and distribution. *Lomelosia deserticola* is found in the deserts of Syria, Jordan, Iraq, Iran, Turkmenistan, Afghanistan, and Pakistan. A detailed distribution, list of specimens, and photographs are provided by Rechinger (1989) and Lack and Rechinger (1991).

Specimen examined. IRAQ. Desertum occidentale (Western desert), inter Ramadi et Rutba, 40 km a Ramadi occidentem versus, 6–7 June 1957, *Rechinger 9817* (B [photo]).

Lomelosia poecilocarpa (Rech. f.) P. Caputo & Del Guacchio, comb. nov. Basionym: *Scabiosa poecilocarpa* Rech. f., Fl. Iranica [Rechinger], 168: 50. 1991. TYPE: "Persia. Bakht.: Inter Dashtak et Cherry 13.VI.1973," *M. Iranshahr & M. Moussavi 15657-E* (holotype, W-photo!; isotype, Herbarium of Evin, Tehran, Iran, not seen).

Habitat and distribution. *Lomelia poecilocarpa* is found in dry, open mountain habitats of Chaharmahal and Bakhtiari Province (southwestern Iran), where it is endemic.

Specimen examined. See above under *Lomelosia deserticola*. Photograph in Lack and Rechinger (1991: tab. 45).

Lomelosia schimperiana (Boiss. & Buhse) P. Caputo & Del Guacchio, comb. nov. Basionym: *Scabiosa schimperiana* Boiss. & Buhse, Nouv. Mém. Soc. Imp. Naturalistes Moscou 12: 112–113. 1860. TYPE: "Persia. 1847, *Buhse s.n.*" (lectotype, designated by Rechinger in Lack & Rechinger [1991: 48], G-BOIS, G00330078-photo!).

The original label reports the name "*Scabiosa Schimperiana* Boiss. et Buhse" as well as the unpublished "*Scabiosa Buhseana* Boiss." The specimen was relabeled by K. H. Rechinger in 1988, who added the locality "Gilan: Rudbar" and the indication "holotypus." Note that in Lack and Rechinger (1991), the treatment of this species (and of all the annual *Scabiosa* species) is authored by Rechinger alone.

Habitat and distribution. *Lomelosia schimperiana* is found in open environments of Gilan Province

(northwestern Iran), where it is endemic. A distribution, list of specimens, and photograph are provided by Lack and Rechinger (1991).

Specimen examined. See above under *Lomelosia deserticola*. Photograph in Lack and Rechinger (1991: tab. 43).

Lomelosia transcaspica (Rech. f.) P. Caputo & Del Guacchio, comb. nov. Basionym: *Scabiosa transcaspica* Rech. f., Willdenowia 19(1): 148. 1989. TYPE: Turkmenistan. "USSR, Turcomania, Kizyl Arvat, Karakala, in monte Sundsodagh, 16.5.1891," *P. Sintenis 1694-a* (holotype, W photo; isotype, B, WU not seen).

Habitat and distribution. *Lomelosia transcaspica* is found in the mountains of Turkmenistan, Azerbaijan (including Nakhchivan), and the Caucasus region. A distribution, list of specimens, and photographs are provided in Rechinger (1989) and Lack and Rechinger (1991).

Specimen examined. See above under *Lomelosia deserticola*. Photograph in Lack and Rechinger (1991: tab. 53).

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A New Variety of *Musa itinerans* (Musaceae) in Taiwan

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ABSTRACT. *Musa itinerans* Cheesman var. *formosana* (Warb.) Häkkinen & C. L. Yeh is one of the three wild bananas in Taiwan and represents the taxon previously recognized as *M. formosana* (Warb. ex Schum.) Hayata [= *M. basjoo* Siebold & Zucc. ex Iinuma var. *formosana* (Warb. ex Schum.) S. S. Ying]. The gross morphology of *M. itinerans* var. *formosana* is stable. Some populations without variegation on the pericarps and the bracts of male buds were mainly found in a restricted area of northeast Taiwan. The morphological characteristics of the nonvariegated populations are otherwise similar to those of *M. itinerans* var. *formosana*. Their principal distinction is based on the absence of the purplish red streaking on both the pericarps and the male, fertile bracts. This character of nonvariegation is stable across the taxon's habitat and as cultivated through a 9-year period of observation. From molecular evidence, the DNA sequence for the ITS region of ribosomal DNA (rDNA) is highly similar in both populations. The nonvariegated population is herein segregated as the new variety, *M. itinerans* var. *kavalanensis* H. L. Chiu, C. T. Shii & T. Y. A. Yang. Photos for the three varietal taxa, *M. itinerans* var. *chinensis*, variety *formosana*, and variety *kavalanensis*, and a key to Taiwanese wild bananas are also provided.

Key words: ICUN Red List, *Musa*, Musaceae, native banana, Taiwan.

The Musaceae are distributed throughout tropical Asia, the Pacific Islands, Africa, and Australia. As currently circumscribed, the family includes three genera, *Musa* L., *Ensete* Horan., and *Musella* (Franch.) C. Y. Wu (Cheesman, 1947; Li, 1978). The largest and most economically important genus in this family is *Musa*, which contains roughly 60 to 70 species (Häkkinen & Väre, 2008), all native to Southeast Asia, ranging from India, Thailand, China, Taiwan, and south to New Guinea and Queensland in Australia. *Musa acuminata* Colla and its hybrids with *M. balbisiana* Colla account for edible bananas and plantains grown worldwide (Simmonds, 1962; Gawel et al., 1992).

Three native *Musa* species in Taiwan have been recognized in the literature, including *M. itinerans* Cheesman var. *formosana* (Hayata) Häkkinen & C. L. Yeh (also known as *M.* ×*paradisiaca* var. *formosana* Warb. ex Schum., *M. formosana* (Warb. ex Schum.) Hayata, or *M. basjoo* Siebold & Zucc. ex Iinuma var. *formosana* (Warb. ex Schum.) S. S. Ying), *M. insularimontana* Hayata, and *M. yamiensis* C. L. Yeh & J. H. Chen, respectively. The first taxon, *M. itinerans* var. *formosana*, has been studied by several taxonomists, e.g., Kao and Lai (1978), Ying (1985), Liaw (1992), Ying (2000), Chiu et al. (2004, 2007, 2010), Chiu (2005), Häkkinen and Väre (2008), and Häkkinen et al. (2010). This taxon was published in 1900 by Schuman, and in 1917 Hayata later transferred it from a variety to a distinct species, i.e., *M. formosana*; however, this rank was also accepted by Kao and Lai (1978), Wu and Kress (2000), Yang et al. (2001), Chiu et al. (2004, 2007, 2010), and Chiu (2005). Furthermore, Ying transferred this Taiwanese native species as a variety of a different species, i.e., *M. basjoo* var. *formosana* in 1985.

Musa basjoo has been commonly referred to as the Japanese fiber banana and is native to the Ryukyu Islands (Baker, 1891; Cheesman, 1948; Wu & Kress, 2000; Turner et al., 2002). In fact, *M. basjoo* is also native to China and grows very commonly in the southern and southwestern parts of the country

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(Amano et al., 1992; Wu & Kress, 2000; Liu et al., 2002). However, the banana cultivated in Ryukyu for fiber actually differs from those plants in China and was recognized as *M. balbisiana* (Jarret, 1987; Amano et al., 1992). *Musa itinerans* var. *formosana* can be easily distinguished from *M. basjoo* by its bract imbrication subtending the male bud (vs. the bracts imbricate at the tip in *M. basjoo*).

Based on the diagnostic character of rhizomatous suckering, *Musa itinerans* var. *formosana* is morphologically close to *M. itinerans* Cheesman, which is also native to China (Liu, 2001). The relationship to *M. itinerans* is supported by phylogenetic analyses of the banana family based on evidence from the ITS region of ribosomal DNA (rDNA) and chloroplast (*trnL-F*) DNA (Liu et al., 2010). Therefore, the combination for *M. formosana* was proposed as *M. itinerans* var. *formosana* by Häkkinen et al. in 2010.

The complex *Musa itinerans* is a highly polymorphic species and several varieties have been reported (Häkkinen et al., 2008, 2010). However, the general morphology of *M. itinerans* var. *formosana* is quite stable and the principal diagnostic characters are as follows: the inflorescences are in compact bunches with purplish red pericarps, the male buds are ovate-lanceolate and variegated with purplish red pigmentation, and the young leaves are usually reddish green abaxially (Chiu et al., 2004; Chiu, 2005). During our field collections over the past 10 years, several populations that lack variegated pericarps and have yellowish green bracts subtending the male buds were found in northeastern Taiwan. For other characteristics, these populations were similar to those of *M. itinerans* var. *formosana*, yet with the principal difference being the lack of variegation, with the pale green pericarps and yellowish green bracts of male buds. These two characters have been stable in each population observed in the field as well as throughout their conserved repository at Taiwan Agricultural Research Institute (TARI) during a 9-year period of observation. Based on detailed morphological comparison involving the relevant literature, and the close similarity of the DNA sequence for the ITS region of rDNA between populations (Chiu, 2005), we treat these nonvariegated populations with pale green pericarps and yellowish green bracts that subtend the male buds as the new variety *M. itinerans* var. *kavalanensis* H. L. Chiu, C. T. Shii & T. Y. A. Yang. The taxonomic description for this newly described taxon, comparable photographs for all three varietal taxa in *M. itinerans*, and a key to Taiwanese bananas are provided.

Materials and Methods

Based on the large, fleshy character of *Musa* plants and the ephemeral aspects of the flowers, their associated herbarium specimens represent poor material to examine (Argent, 2000). Fresh material as clones of the nonvariegated populations of *M. itinerans* were collected from northeastern Taiwan and conserved at TARI, Taichung, Taiwan. These characteristics were recorded according to the Revised List for Banana Descriptors (IBPGR, 1984; IPGRI-INIBAP/CIRAD, 1996). Our knowledge of the nonvariegated populations is based on the study of more than 50 living accessions in their native habitat and at the conserved repository at TARI.

Taxonomic Treatment

1. Musa itinerans Cheesman, Kew Bull. 4(1): 23. 1949. TYPE: Myanmar [Burma]: Myitkyina Distr., Tagwin Chaung, evergreen forests, 400 ft., 24 Nov. 1928, *C. E. Parkinson 1761* (lectotype, designated by Liu et al. [2002: 79], K not seen).

1a. Musa itinerans var. **chinensis** Häkkinen, Novon 18(1): 51. 2008. TYPE: China. Guangdong: Conghua, Daling Mtn., 500 m, 2 Apr. 2006, *M. Häkkinen 514* (holotype, IBSC not seen; isotypes, H not seen, HITBC not seen, MO not seen). Figure 1A, B.

Selected specimen examined. TAIWAN. **Hsinchu Co.:** Peipu Township, 20 May 2008, *H. L. Chiu 2* (TNM).

1b. Musa itinerans var. **formosana** (Warb. ex Schum.) Häkkinen & C. L. Yeh, Acta Phytotax. Geobot. 61(2): 44. 2010. Basionym: *Musa* ×*paradisiaca* var. *formosana* Warb. ex Schum., Pflanzenr. (Engler) IV (Heft 1): 21. 1900. *Musa formosana* (Warb. ex Schum.) Hayata, Icon. Pl. Formosan. 6 (Suppl.): 83. 1917. *Musa basjoo* Siebold & Zucc. ex Iinuma var. *formosana* (Warb. ex Schum.) S. S. Ying, Mem. Coll. Agric. Nation. Taiwan Univ. 25: 100. 1985. TYPE: Taiwan [Formosa]. Uchiko, Yusuikyo, 17 Sep. 1916, *B. Hayata s.n.* (neotype, Häkkinen & Väre [2008: 88], TI). Figure 1C, D.

Selected specimens examined. TAIWAN. **Hsinchu Co.:** Wufong Township, 25 June 2010, *H. L. Chiu & K. C. Chang 10* (TNM). **Ilan [Yilan] Co.:** Tatung Township, Tuchang, 24 June 2010, *H. L. Chiu 8*, *H. L. Chiu 9* (TNM), 24 June 2010; Songlou, Prov. #7 Hwy. 98.2 Km, 24 June 2010, *H. L. Chiu 7* (TNM); Wangliuan, 15 June 2010, *H. L. Chiu & Y. C. Chen 3* (TNM). **Nantou Co.:** Luku Township,

Figure 1. A–B. *Musa itinerans* var. *chinensis* Häkkinen. —A. Male bud yellowish green with purple-red streaks and one fruit finger with pale-green pericarp and fertile male flowers. —B. Inflorescence with pale-green pericarps and yellowish green bracts with purple-red streaks. C–D. *M. itinerans* var. *formosana* Häkkinen & C. L. Yeh. —C. Inflorescence with yellowish green bracts variegated with purple-red streaks and pink-red pericarps if ovaries were fertilized or pale green pericarps if ovaries were not fertilized. —D. The basal nodes of the inflorescence, bearing female flowers with yellow-green bracts streaked with purple-red. E–H. *M. itinerans* var. *kavalanensis* H. L. Chiu, C. T. Shii & T. Y. A. Yang. —E. Plants in the field, from Nioudou, Yilan Co., the type locality. —F. Inflorescence in field. —G. Plants under cultivation at TARI. —H. Developing inflorescence at TARI. All photos were taken by H. L. Chiu.

Figure 2. Holotype of *Musa itinerans* var. *kavalanensis* H. L. Chiu, C. T. Shii & T. Y. A. Yang (*Chiu 1*, sheet 2 of 5, TNM).

Shanlinhsi, Chinese Zodiacal Sign Ox-Tiger, 9 Dec. 2008, *T. Y. A. Yang et al. 21187* (TNM). **Taitung Co.:** Taimali Township, Taimali logging track, 29 Sep. 1999, *S. T. Chiu 5482* (TNM). **Taoyuan Co.:** Fuhsing Township, Neikueihui, 16 Oct. 2008, *C. M. Wang 12331* (TNM).

Notes. Musa itinerans var. *formosana* is distributed across the entire island of Taiwan as well as its offshore islands in subtropical and tropical areas at altitudes from 200 to 1200 m, along roadsides, in river valleys and ravines, and on gentle or steep slopes. Large populations often occur in valleys or along rivers. It can withstand frost or snow when this occurs. Where frost kills the leaves, the pseudostem remains alive and new leaves emerge as temperatures rise. However, *M. itinerans* var. *chinensis* occurs only occasionally among the populations of variety

Figure 3. Isotype of *Musa itinerans* var. *kavalanensis* H. L. Chiu, C. T. Shii & T. Y. A. Yang (*Chiu 1*, sheet 5 of 5, TNM).

formosana, and its chromosome number of $2n = 22$ was determined by Chiu et al. (2010).

The pigmentation of *Musa itinerans* var. *formosana* on young leaves, pericarps, and bracts of male buds is developmentally uniform, but varies in the intensity and area of coverage in variegated streaking. The extent of streaking on the pericarps and bracts of the male buds can range from minimal to entirely covering the surface, and the pigmented intensity on the pericarps may be light initially and then darken with maturity. The principal difference between variety *formosana* and variety *chinensis* is the purplish red streaking on the pericarps only. In contrast, the pericarps of variety *chinensis* remain pale green even

at maturity. This variegation or its absence was a stable character throughout the field investigations. Otherwise, it is hard to distinguish variety *chinensis* from variety *formosana* at vegetative stages.

1c. Musa itinerans var. **kavalanensis** H. L. Chiu, C. T. Shii & T. Y. A. Yang, var. nov. TYPE: Taiwan. Ilan [Yilan] Co., Tatung Township, Nioudou, 20 May 2008, *H. L. Chiu 1* (holotype, TNM S133047, 1 of 5; isotypes, TNM S133047, 2 to 5 of 5 [4]). Figures 1E–H, 2, 3.

Haec varietas a *Musa itinerante* Cheesman var. *formosana* (Warb. ex Schum.) Häkkinen & C. L. Yeh pericarpio atque bracteis fertilibus omnibus non rubro-variegatis differt.

Plants freely stoloniferous, developing long rhizomes 15 cm or more from the parent plant, position vertical, up to 5 suckers; mature pseudostems 2.5 m tall or more, to 4 m, 28–44 cm diam. at base, green with varying development of red-brown pigmentation according to age and exposure; the pseudostem covered with varying amounts of dead brown leaf sheaths, the underlying color light green with large red-brown blotches, shiny; sap watery. Leaf sheaths and petioles devoid of wax; leaf blades developing on the fourth, fully unfolded leaf basipetally from the plant apex, ca. 175–220 × 47–59 cm, bases obtusely rounded to oblique, entire, the apex obtuse, lateral venation pinnate and parallel, midrib usually prominent, blades often tearing between the lateral veins, yellowish green to green on both surfaces, glabrous; petioles 30–40 cm, usually green, caniculate with the canal wide, margins narrow, membranous and erect, not clasping the pseudostem. Inflorescence at first semi-erect to horizontal and then falling vertically downward; peduncle ca. 55–80 cm, robust, pale green to rusty brown, densely puberulent; sterile bracts 2, bracts deciduous at opening of the first flowers; basal flowers bisexual, the others male; spathe long-lingulate, 31.7 × 11.4 cm wide at center, apex convolute, bracts yellowish green, revolute and lifting one at a time after flowering, with the subsequent 1 to 2 bracts acropetally revolute, lifting before the older bract is deciduous; bract scars prominent. Flowers 11 to 13 per bract, biseriate, ovary inferior, pale green, glabrous, ca. 4.6 cm, markedly 5-angled, locules 3, ovules disposed in 4 rows; compound tepals ca. 4.8 cm, with 2 prominent thickened keels, ribbed at the dorsal angles, with 5-lobed, pale yellow apex, free tepals translucent white, ca. 3.2 cm, oblong-acuminate, smooth; stamens 5 with sterile pollen, ca. 5.2 cm, filaments white, anther pale yellow; style straight, ca. 4.1 cm, creamy white, stigma capitate, grayish black after pollination. Male buds lanceolate, 15.8 × 7.5 cm, pendulous, bracts yellowish green on both sides, convolute at the tip; bract lifting sequentially as 1 bract at a time, lifting and revolute, similar to those subtending the lower flowers; bract scars prominent. Male flowers 14 to 15 per bract, in 2 rows, falling with the bract, compound tepals usually 5-lobed, ca. 4.5 cm, pale yellow, central lobes smaller than the outer lobes; free tepals translucent white, ca. 2.2 cm, oblong-acuminate, stamens 5, filaments white, ca. 4.3 cm; fertile gynoecium 1, style straight, stigma cream, ca. 4.3 cm, ovary arched, pale green, glabrous, 1.1 cm. Fruits bunch nearly horizontally, compact, with 3 to 10 hands per bunch. Individual fruit usually negatively geotropic, ca. 6.7–8.5 × 2.5–2.8 cm in diam., ca. 21–38 g in weight, straight, slightly ridged, obscurely 5-angled at maturity, apically blunt with persistent floral remains; fruit pedicels 1.1–1.4 cm, pale green, minutely puberulent; immature pericarp whitish green, minutely puberulent, becoming pale green and splitting lengthwise occasionally at maturity, dull yellow at full ripeness, not strongly aromatic, sweet and sour taste; seeds small, dark brown, warty, ca. 2.1 × 4.1–4.8 mm diam., irregularly angulate-depressed, 100 seeds with a weight of 2.9 g.

Etymology. The epithet of the new variety honors the traditional name of the aboriginal people in Yilan County (the Kavalan).

Distribution and habitat. The known populations of *Musa itinerans* var. *kavalanensis* occur in mountainous areas at elevations from 220 to 820 m, along the 202 logging track (Yingshih village) on gentle slopes and the roadside of Prov. 7 Highway (Nioudou village), Yilan County, which is located in northeastern Taiwan. No individual or population of variety *kavalanesis* has been found within the distributional areas of either *M. itinerans* var. *formosana* or variety *chinensis*.

IUCN Red List category. Musa itinerans var. *kavalanesis* was investigated by the authors in Taiwan from 1999 to 2010. For its conservation assessment, IUCN Red List categories were applied (IUCN, 2001). These native banana populations occur mainly in open places in mountainous areas at Nioudou and Yingshih villages, Yilan County, at altitudes from 220 to 820 m. Both observed and conserved materials of *M. itinerans* var. *kavalanesis* and variety *formosana* were occasionally seen as growing sympatrically. However, no obvious hybrids were observed in those populations. This taxon is of minimal conservation concern and should be considered Least Concern (LC).

Table 1. Diagnostic morphological characters of the three varieties of *Musa itinerans* Cheesman in Taiwan and Hainan. *Musa itinerans* var. *formosana* (Warb. ex Schum.) Häkkinen & C. L. Yeh and *M. itinerans* var. *kavalanensis* H. L. Chiu, C. T. Shii & T. Y. A. Yang are found in Taiwan; *M. itinerans* var. *hainanensis* Häkkinen & X. J. Ge occurs in Hainan. The description of variety *formosana* is based on personal observations by the authors, and the description of variety *hainanensis* is taken from Häkkinen et al. (2010).

	var. *formosana*	var. *hainanensis*	var. *kavalanesis*
Plant height	to 3 m	to 4 m	to 4 m
Rhizome length	0.3–1 m from parent plant	0.5–2 m from parent plant	0.3–1 m from parent plant
Number of suckers	to 5 (rhizomatous)	to 5 (rhizomatous)	to 5 (rhizomatous)
Leaf habit	normal (intermediate)	normal (erect)	normal (intermediate)
Underlying color of the pseudostem	light-green	light-green	light-green
Pigmentation of the underlying pseudostem	red-brown to black blotches	large black blotches	red-brown blotches
Sap consistency	watery	milky	watery
Petiole margins	erect	spreading	erect
Leaf size	180 × 52 cm	250 × 50 cm	175–220 × 47–59 cm
Color of adaxial surface of leaf	green	dark green	green
Peduncle color	pale green to rusty brown	green to rusty brown	pale green to rusty brown
Basal flowers	8 to 12 in two rows on average, bisexual	15 in two rows on average, bisexual with androecium reduced	11 to 13 in two rows on average, bisexual
Male bud shape and size	ovate-lanceolate, 13 × 7 cm	ovoid, 12 × 7 cm	lanceolate, 15.8 × 7.5 cm
Color of the external face of the bract	yellowish green with purple-red streaking apically	pale yellow, tinted with green	yellowish green
Male bract lifting and dehiscence pattern	lifting one bract at a time, revolute	lifting two bracts at a time, revolute	lifting one bract at a time, revolute
Male flowers per bract	12 to 17 in two rows	17 in two rows on average	11 to 13 in two rows
Number of fruits	3 to 11 hands, 8 to 12 fruits per hand on average	9 hands, 15 fruits per hand in two rows on average	3 to 10 hands, 11 to 13 fruits per hand on average
Fruit length and shape	7 cm, straight and ridged	6.5 cm, rounded	6.7–8.5 cm, straight and slightly ridged
Fruit pedicel	3 cm, pubescent	4.5 cm, pubescent	1.1–1.4 cm, minutely puberulent
Immature pericarp color	pale green tinted with purple-red spots	pale green	whitish green
Mature pericarp color	pale green tinted with variable purple-red streaks	dull black	pale green
Fruit at maturity	splitting lengthwise occasionally	splitting lengthwise	splitting lengthwise occasionally

Note. A new variety of *Musa itinerans* was described recently as variety *hainanesis* Häkkinen & X. J. Ge by Häkkinen et al. (2010), with pale green pericarps equipped with yellowish green bracts of male buds. The distinguishing characteristics of *M. itinerans* var. *kavalanesis*, variety *hainanesis*, and variety *formosana* are provided in Table 1.

Paratypes. TAIWAN. **Ilan [Yilan] Co.:** Tatung Township, Yingshih, #202 logging track 4.2 km, male flowers, 2 Sep. 2010, *H. L. Chiu 12* (K, MO, TAI, TI, TNM), #202 logging track 5.8 km, female flowers, 2 Sep. 2010, *H. L. Chiu 14* (KUN, TNM).

KEY TO THE SPECIES OF *MUSA* AND VARIATIONS OF *M. ITINERANS* IN TAIWAN

1a. Plants rhizomatous.
  2a. Fertile bracts yellowish green; pericarps pale green, both lacking reddish variegation..... *Musa itinerans* var. *kavalanensis*
  2b. Fertile bracts yellowish green, variegated with purplish red streaks toward apex.
    3a. Pericarps pale green..... ..... *Musa itinerans* var. *chinensis*
    3b. Pericarps pale green, variegated with purplish red streaks..... ..... *Musa itinerans* var. *formosana*

1b. Plants not rhizomatous.
4a. Bracts dark purplish red abaxially.....
..... *Musa insularimontana* Hayata
4b. Bracts yellowish green abaxially.....
..... *Musa yamienesis* C. L. Yeh & J. H. Chen

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Novae Gesneriaceae Neotropicarum XVII: New Combinations and Typifications

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Abstract. Fieldwork and current research projects in Central and South America on the Gesneriaceae have shown that nomenclatural and taxonomic changes are needed. The Ecuadorian endemic species *Columnea albovinosa* (M. Freiberg) J. L. Clark & L. E. Skog is transferred from *Dalbergaria* Tussac. The name *Pentadenia lutea* M. Freiberg is synonymized with *C. angustata* (Wiehler) L. E. Skog. *Amalophyllon ecuadoranum* (Wiehler) J. L. Clark, comb. nov., is recognized as a species distinct from *A. divaricatum* (Poepp.) Boggan, L. E. Skog & Roalson. The application of the name *C. serrata* (Klotzsch ex Oerst.) Hanst. is stabilized by the designation of a neotype. The new name *Drymonia ovatifolia* J. L. Clark is made for the species *Nautilocalyx dressleri* Wiehler. *Resia bracteata*, a name originally published without a Latin diagnosis, is here validly published as *R. bracteata* J. L. Clark & L. E. Skog.

Resumen. El trabajo de campo en Gesneriaceae realizado en Centro y Sur América, ha evidenciado la necesidad de realizar algunos cambios taxonómicos y nomenclaturales. *Columnea albovinosa* (M. Freiberg) J. L. Clark & L. E. Skog, especie endémica de Ecuador, se transfiere de *Dalbergaria* Tussac. *Pentadenia lutea* M. Freiberg es sinonimizada con *C. angustata* (Wiehler) L. E. Skog. Se reconoce a *Amalophyllon ecuadoranum* (Wiehler) J. L. Clark, comb. nov., como una especie diferente de *A. divaricatum* (Poepp.) Boggan, L. E. Skog & Roalson. Para preservar la estabilidad de la especie se designa un neotipo para *C. serrata* (Klotzsch ex Oerst.) Hanst. Se crea un nuevo nombre, *Drymonia ovatifolia* J. L. Clark, para la especie *Nautilocalyx dressleri* Wiehler. La especie *Resia bracteata*, originalmente publicada sin la diagnosis en latín, es válidamente publicada como *R. bracteata* J. L. Clark & L. E. Skog.

Key words: *Alloplectus*, *Amalophyllon*, Colombia, *Columnea*, Costa Rica, *Dalbergaria*, Ecuador, Gesneriaceae, Panama, *Pentadenia*, Peru, *Resia*, Venezuela.

Recent fieldwork in Central and South America has resulted in the need to stabilize the nomenclature of six species in the Gesneriaceae. Herbarium research for ongoing projects and fieldwork to type localities has made it possible to elaborate and clarify the circumscription and nomenclature of previously confused taxa.

Amalophyllon ecuadoranum (Wiehler) J. L. Clark, comb. nov. Basionym: *Phinaea ecuadorana* Wiehler, Gesneriana 1: 84, fig. 28. 1995. TYPE: Ecuador. El Oro: along rd. from Loja to Santa Rosa, 20 km past Piñas, 17 Apr. 1986, *H. Wiehler & GRF Expedition 8652* (holotype, QCNE; isotypes, B, E, K, MO, NY, QCA, SEL, US).

This species is widely distributed throughout the horticultural community. The live collections probably originated from cuttings from the holotype (*H. Wiehler & GRF Expedition 8652*) that were distributed by Hans Wiehler from the Gesneriad Research Foundation in the 1980s. This species was treated as a synonym of *Amalophyllon divaricatum* (Poepp.) Boggan, L. E. Skog & Roalson during a recent reorganization and review of the genera *Amalophyllon*, *Niphaea* Lindl., and *Phinaea* Benth. (Boggan et al., 2008). It was noted by Boggan et al. that their circumscription of *A. divaricatum* was broad and that further studies could well indicate that the Ecuadorian and Peruvian populations should be recognized as distinct species. A 2010 research expedition to northern Peru documented extant populations of *A. divaricatum* from the province of San Martín (*J. L. Clark et al. 11934* [UNA, US, USM] and *J. L. Clark et al. 11910* [BRIT, K, MO, NY, SEL, UNA, US,

USM]). As predicted by Boggan et al. (2008), the populations of *A. divaricatum* from northern Peru differ significantly from those in Ecuador and therefore the two are not conspecific.

Some of the obvious differences between these two species are the larger leaves (3–9 cm), elongate shoots with evenly spaced leaves, and a more robust habit in *Amalophyllon ecuadoranum* (Fig. 1). The leaves of *A. divaricatum* are smaller (usually less than 4 cm) and in a basal rosette (Fig. 2). It should be noted that there is considerable variation in *A. divaricatum* from northern Peru (Boggan et al., 2008) and that further studies may merit recognition of additional species.

Nomenclatural and Taxonomic Actions in *Columnea*

1. Columnea albovinosa (M. Freiberg) J. L. Clark & L. E. Skog, comb. nov. Basionym: *Dalbergaria albovinosa* M. Freiberg, Phyton (Horn) 37: 134, fig. 1B. 1997. TYPE: Ecuador. Imbabura: Los Cedros Biological Reserve, 00°19′N, 78°47′W, 1600–1700 m, 29 June 1996, *M. Freiberg 96216* ([published type distribution] holotype, QCA; isotypes, ULM, QCNE [actual type distribution, holotype, QCA; isotype, ULM]). Figure 3.

Columnea albovinosa is similar to *C. rubriacuta* (Wiehler) L. P. Kvist & L. E. Skog in the dorsiventral habit, tubular corollas with a nearly radial limb, short corolla lobes, and nearly sessile flowers (Figs. 3, 4). The two species differ by the presence of a white corolla with red lobes in *C. albovinosa* (Fig. 3) and uniformly bright yellow corollas in *C. rubriacuta* (Fig. 4). Freiberg (1997) cited only the type collection in the description of *C. albovinosa*. Additional populations have been documented in the private reserve of the Bosque Integral Otonga in the province of Cotopaxi, Ecuador, on the western slopes of the Andes (*J. L. Clark, F. Nicolalde & R. Hall 7386*, AAU, COL, E, F, K, MO, NY, QCA, QCNE, SEL, UNA, US) and in the Awá community of San Francisco near Lita in the province of Imbabura, Ecuador, near the border with Esmeraldas and Carchi (*J. L. Clark, R. Hall & F. Nicolalde 752*, AAU, COL, E, F, K, MO, NY, QCA, QCNE, SEL, UNA, US). Current revisionary work in *Columnea* L. by others may result in the synonymy of these two species.

This species and the one following were among 10 published by Martin Freiberg based on collections from expeditions in northwestern Ecuador (Freiberg, 1996, 1997, 1998, 2000). Some of the types designated by Freiberg and isotypes cited in his publications as being at Ecuadorian herbaria have either not yet been distributed or are still only available from the University of Ulm (ULM). For example, no Freiberg collections have been found at the Museo Ecuatoriano de Ciencias Naturales (QCNE), even though isotypes were cited as being there. Thirty collections are deposited at Pontificia Universidad Católica del Ecuador (QCA), but some of the collections that Freiberg had labeled as types at QCA do not match collection numbers cited in the protologues of the species. The first author visited type localities of many of Freiberg's species in 2001 and 2003 and studied all the available type material at QCA.

2. Columnea angustata (Wiehler) L. E. Skog, Ann. Missouri Bot. Gard. 65(3): 844. 1978 [1979]. Basionym: *Pentadenia angustata* Wiehler, Selbyana 2(1): 118–119, tab. 33C. 1977. TYPE: Colombia. El Valle: old rd. from Cali to Buenaventura, 8 km past La Elsa, 30 Apr. 1972, *H. Wiehler, Dressler & Williams 7276* (holotype, SEL; isotypes, COL, K, MO, NY, US).

Pentadenia lutea M. Freiberg, Phyton (Horn) 37: 133 140. 1997. TYPE: Ecuador. Imbabura: Los Cedros Biological Reserve, 00°19′N, 78°47′W, 1300 1400 m, 22 Mar. 1996, *M. Freiberg 96019* ([published type distribution] holotype, QCA; isotypes, ULM, QCNE [actual type distribution, holotype, QCA; isotype, ULM (2)]).

Pentadenia lutea is a synonym of the widespread taxon *Columnea angustata* (Wiehler) L. E. Skog. It should be noted that *P. ecuadorana* Wiehler and *C. sericea* Mansf. (nom. illeg.) are also treated as synonyms of *C. angustata*. This taxon is differentiated from other congeners by the combination of the following characters: presence of isophyllous leaves in contrast to anisophyllous leaves; elongate shoots with evenly spaced leaves in contrast to dorsiventral shoots with clustered leaves; nectary with five lobes in contrast to single lobes; and narrowly tubular corollas in contrast to strongly bilabiate corollas.

3. Columnea serrata (Klotzsch ex Oerst.) Hanst., Linnaea 34: 390. 1865. Basionym: *Stenanthus serratus* Klotzsch ex Oerst. Centralamer., Gesner. 49. 1858. *Ortholoma serratum* (Klotzsch ex Oerst.) Wiehler, Phytologia 27: 323. 1973. *Trichantha serrata* (Klotzsch ex Oerst.) Wiehler, Selbyana 1(1): 35. 1975. TYPE: Costa Rica. Heredia: Sarapiquí, Rara Avis, ca. 15 km suroeste de Horquetas, 10°16′48″N, 08°01′48″W, 400–600 m, 8 Nov. 1989, *O. Vargas 291* (neotype, designated here, INB; isoneotype, MO). Figure 5.

The name *Columnea serrata* has been confused with and applied to specimens of several superficially

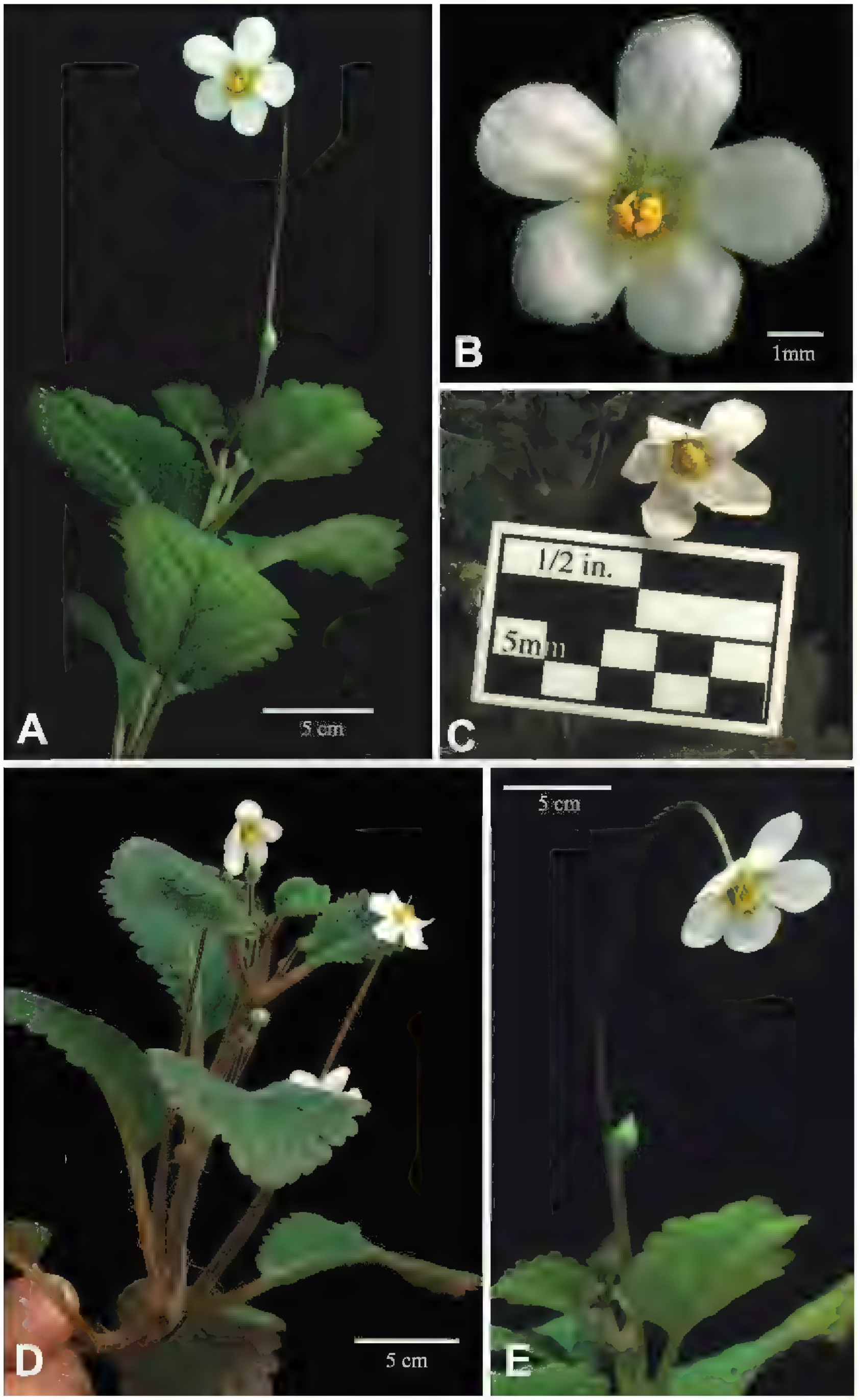


Figure 1. *Amalophyllon ecuadoranum* (Wiehler) J. L. Clark. —A, D. Habit showing elongate stem with evenly spaced leaves. —B, C. Face view of corolla. —E. Flower during anthesis with long, slender, curving pedicel. Note that the flowers as shown are resupinate, which may not be their natural orientation. Images A–E of voucher *J. L. Clark 8840* (US and United States Botany Research Greenhouse acc. # 1988-009). Photos by James Di Loreto (Smithsonian Institution National Museum of Natural History [NMNH] Imaging).

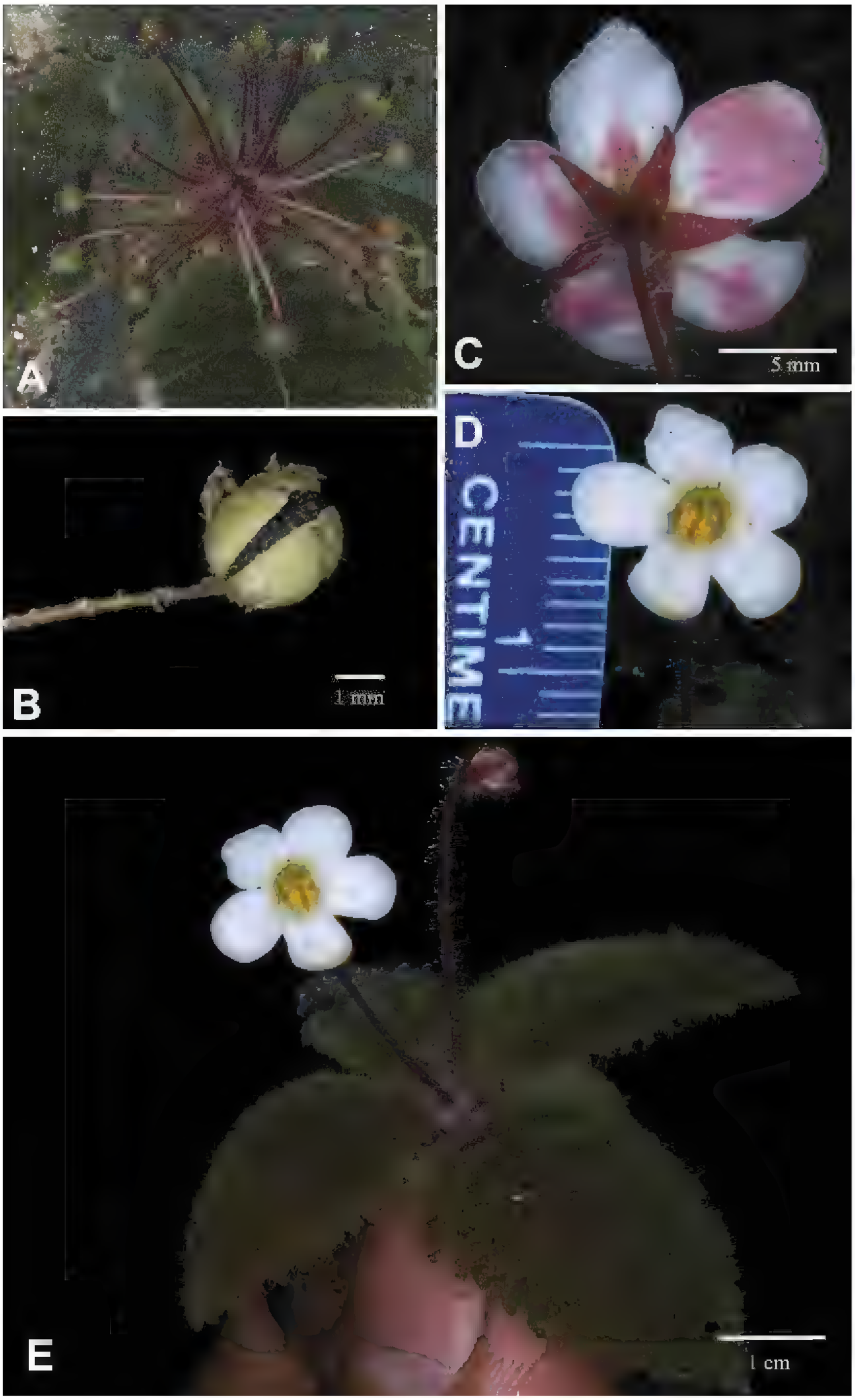
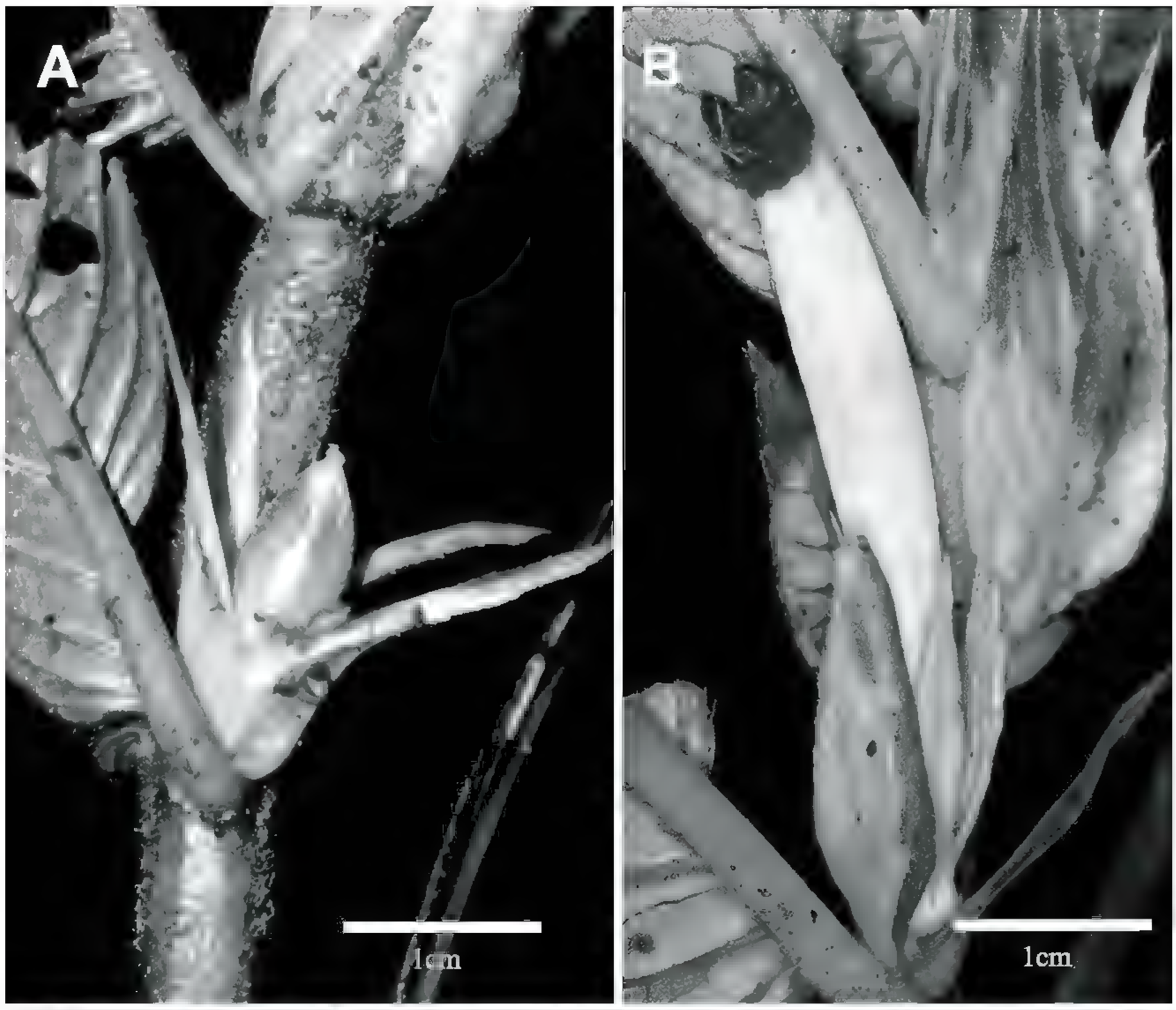


Figure 2. *Amalophyllon divaricatum* (Poepp.) Boggan, L. E. Skog & Roalson. —A. Terminal cluster of pedicels. —B. Mature bivalved capsule. —C. Rear view of mostly white flower; base of corolla lobes white suffused with pink. —D. Face view of uniformly white corolla. —E. Habit showing basal rosette of leaves with erect pedicels. Images A–E of field collection *J. L. Clark et al. 11910* (BRIT, K, MO, NY, SEL, UNA, US, USM).



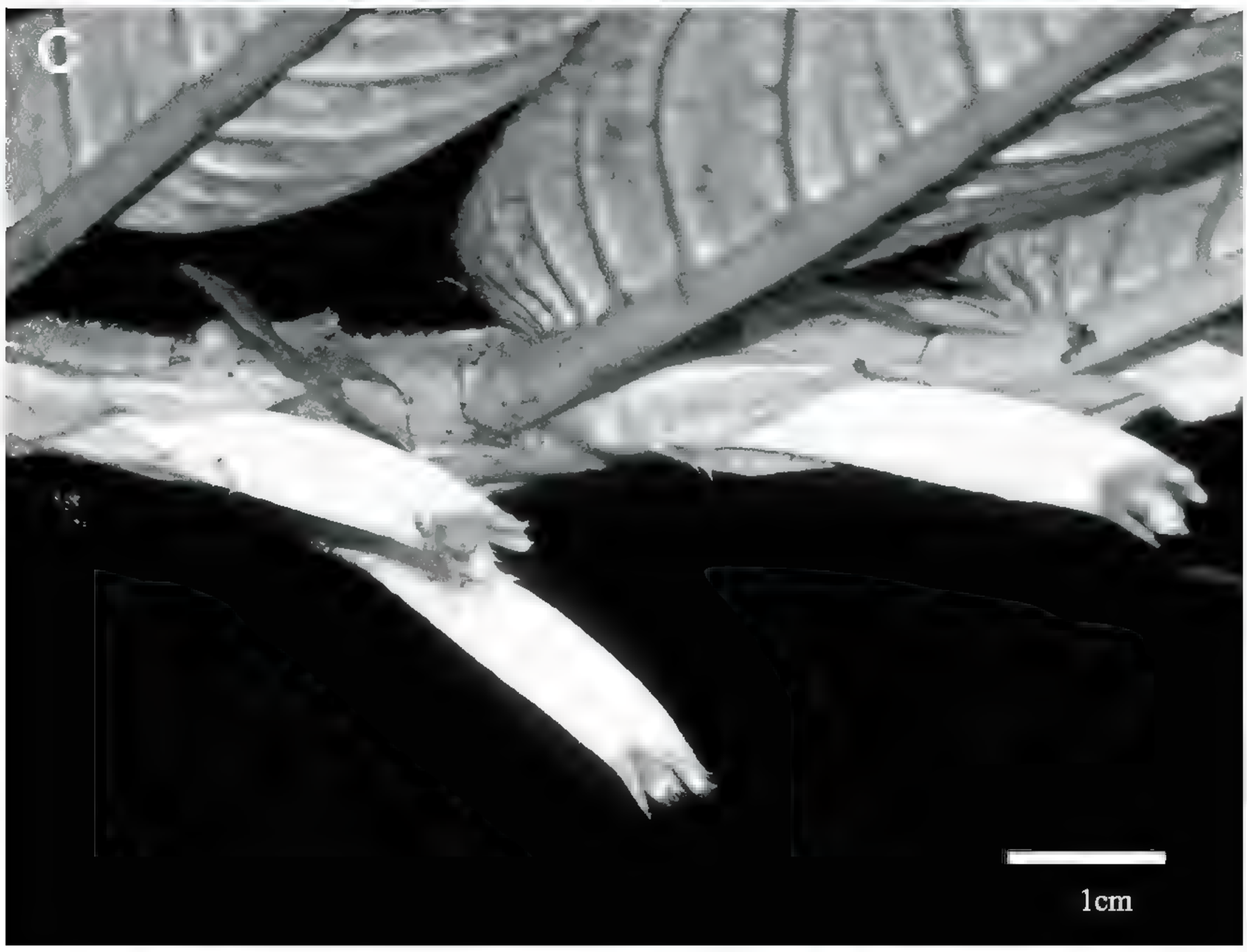


Figure 3. *Columnea albovinosa* (M. Freiberg) J. L. Clark & L. E. Skog. —A. Mature elongate berry. —B, C. Tubular flower; corolla white with red lobes. Images A and C from field collection *J. L. Clark, A. Muñoz & C. Tapia 6158* (COL, NY, QCA, QCNE, US), B from *J. L. Clark, F. Nicolalde & R. Hall 7386* (MO, QCNE, SEL, UNA, US).

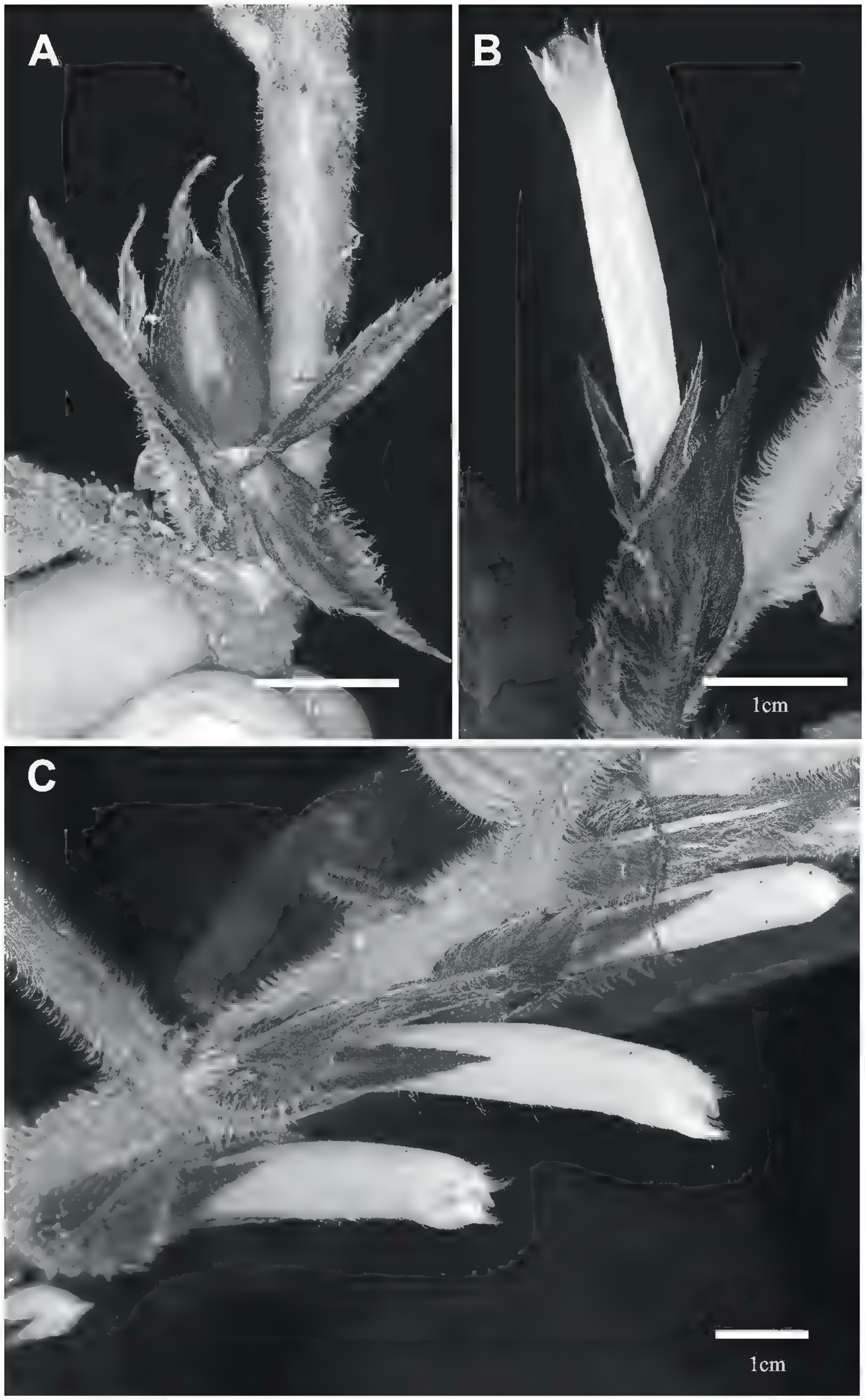
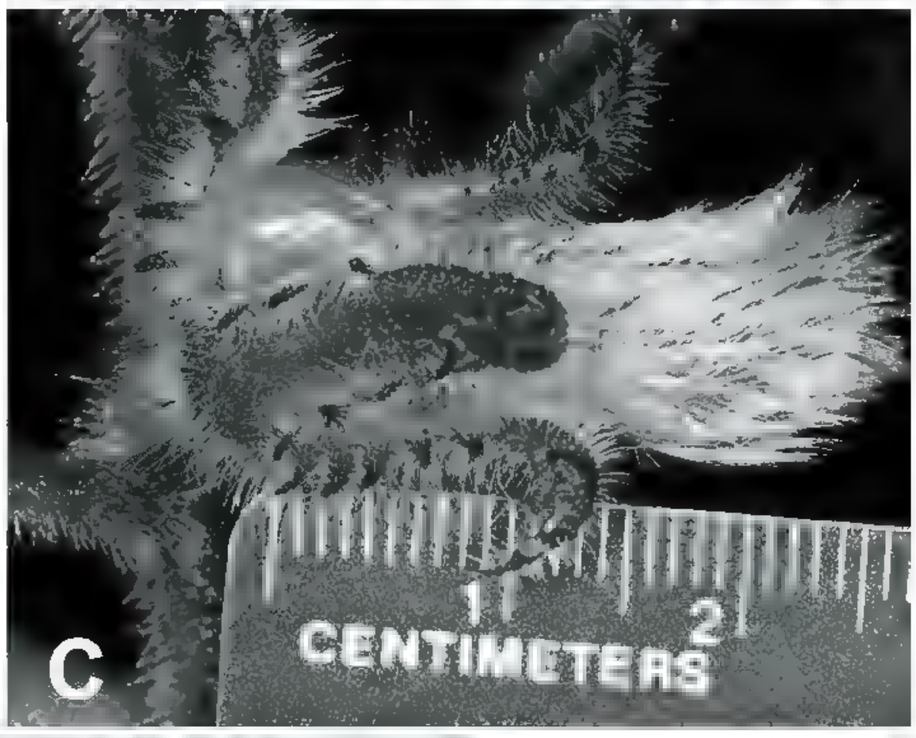


Figure 4. *Columnea rubriacuta* (Wiehler) L. P. Kvist & L. E. Skog. —A. Mature elongate berry. —B, C. Uniformly tubular yellow corolla. Images A from field collection *J. L. Clark et al. 7493* (COL, NY, QCA, QCNE, US), B from *J. L. Clark 8807* (MO, QCNE, SEL, UNA, US), C from *J. L. Clark 10122* (MO).

Figure 5. Neotype specimen of *Columnea serrata* (Klotzsch ex Oerst.) Hanst., *O. Vargas 291* (INB).

similar species. The confusion arises from the shared character of the fimbriate calyx (Figs. 5–7). The misidentified material falls into two groups. The first includes specimens that are correctly identified as *Alloplectus weirii* (Kuntze) Wiehler (Fig. 6), one of only five species currently included in *Alloplectus* Mart. (Clark, 2005). The second group includes species currently recognized in *Columnea*, including *C. sanguinolenta* (Klotzsch ex Oerst.) Hanst., *C. segregata* B. D. Morley, and *C. purpurata* Hanst. In



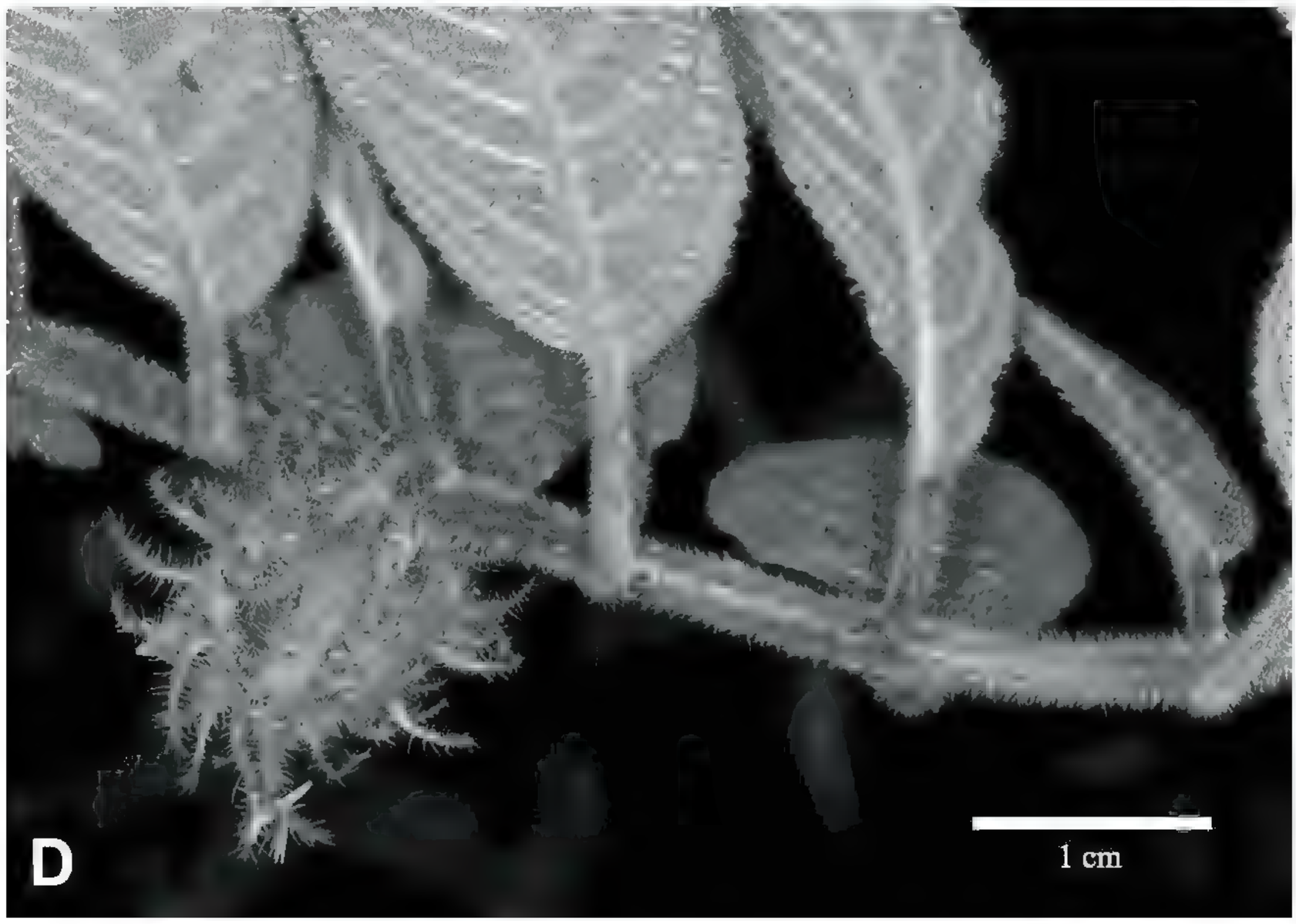


Figure 6. *Alloplectus weirii* (Kuntze) Wiehler. —A. Holotype of *Columnea weirii* Kuntze, *J. Weir 217* (K). —B. Front view of corolla. —C. Lateral view of flower. —D. Vegetative stem showing isophyllous leaves and mature calyx. Images B and C from field collection *J. L. Clark, L. Bohs & N. Leon 8914* (LOJA, QCA, QCNE, US), D from *J. L. Clark 9881* (AAU, COL, E, F, MO, NY, QCNE, SEL, UNA, US).

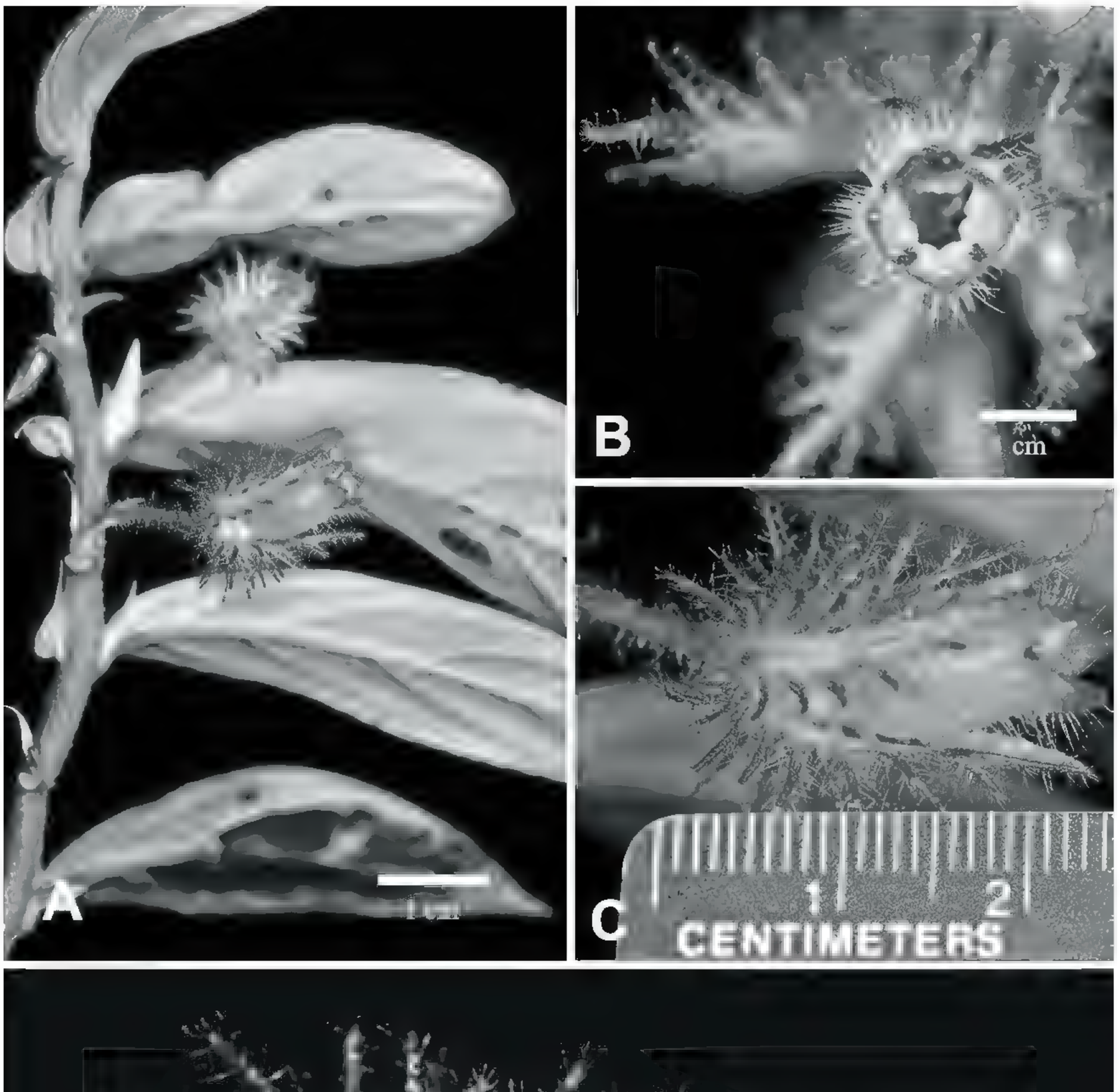


Figure 7. *Columnea serrata* (Klotzsch ex Oerst.) Hanst. —A. Vegetative stem showing anisophyllous leaves and mature flower. —B. Front view of corolla. —C. Lateral view of flower with scale. —D. Lateral view of flower. Images A–D of field collection *J. L. Clark & J. Katzenstein 8878* (SEL, US).

both groups, the leaves are opposite, the flowers are borne singly or in pairs in the leaf axils, and the calyx is fimbriate. However, in *A. weirii*, the leaves are equal or subequal in size and the fruit, as in all species of *Alloplectus*, is a fleshy capsule. In *Columnea* the fruit is a berry and, in this group of species, the leaves are borne in markedly unequal pairs. Oersted (1858) describes the leaves of *Stenanthus serratus* as being in unequal pairs. Consequently, the name cannot apply to *A. weirii* but rather to a species of *Columnea*.

In the protologue of *Stenanthus serratus*, Oersted (1858) indicated that he took the name, and possibly the description, from a manuscript written by Klotzsch. The description is based on a Warscewicz specimen that was housed in the Berlin herbarium, which Hanstein (1865: 390) gives as *Warscewicz 19*, but has since been destroyed. We have been unable to locate a duplicate specimen. The neotype designated here has been selected to conform as closely as possible to the original description. As with most of Warscewicz's collections, the locality is ambiguous. Warscewicz collected in both Costa Rica and Panama, but the labels on his specimens are rarely specific with respect to locality, typically citing "Costa Rica et Veragua" or "Veragua." Thus it is not unreasonable to assume that the type of *C. serrata* was collected in Costa Rica.

The relationship of *Columnea serrata* to the other species of *Columnea* with a toothed or fimbriate calyx is currently under consideration as two of the authors (Barrie and Skog) prepare a treatment of the genus for the Flora Mesoamericana project.

A New Name in *Drymonia*

Drymonia ovatifolia J. L. Clark, nom. nov. Replaced name: *Nautilocalyx dressleri* Wiehler, Selbyana 2: 114, fig. 32D. 1977, non *Drymonia dressleri* Wiehler, Selbyana 5: 80, fig. 2C 1978. TYPE: Panama. Coclé: hills N of El Valle de Antón, 800 m, 17 Jan 1973, *R. L. Dressler 4258* (holotype, SEL; isotype, MO).

The new name and transfer made here reflect recent phylogenetic results (Clark et al., 2006) that strongly support the inclusion of this taxon in *Drymonia* and not in *Nautilocalyx* Linden ex Hanst. *Drymonia ovatifolia* is widespread in Panama (Chiriquí, Coclé, Comarca Kuna Yala, Darién, Panamá, and Veraguas) and Costa Rica (Limón). The erect unbranched habit and membranous leaf texture are features that *D. ovatifolia* shares with *D. foliacea* (Rusby) Wiehler and *D. crenatiloba* (Mansf.) Wiehler. These three species were strongly supported in a clade based on molecular and morphological data presented in Clark et al. (2006). Wiehler (1977) noted that the anthers of *D. ovatifolia* dehisce by complete longitudinal slits, but observations by the first author of the holotype (*Dressler 4258*) suggest that the sagittate anthers are in an early stage of anthesis with basal pores. This sort of dehiscence was described in Clark et al. (2006) as an intermediate pore stage that later develops into longitudinal dehiscence when the flowers are mature.

Validation and New Combination of a Name in *Resia*

Resia bracteata J. L. Clark & L. E. Skog, sp. nov. *Resia ichthyoides* subsp. *bracteata* L. E. Skog & F. de Jesus, BioLlania (Ed. Espec.) 6: 520. 1997, nom. inval. [no diagnosis]. *Resia bracteata* (L. E. Skog & F. de Jesus) Fern. Alonso, Revista Acad. Colomb. Ci. Exact 30: 175. 2006, nom. inval. TYPE: Colombia. Santander: Mpio. Charala, 25 June 1993, *X. Londono & L. P. Kvist 812* (holotype, COL; isotypes, AAU, HUA, K, MO, TULV, US, VEN).

Haec species ab aliis speciebus *Resiae* H. E. Moore inflorescentiis bracteatis differt.

In a review of *Resia* H. E. Moore from Colombia and Venezuela, Skog and de Jesus (1997) proposed a subspecies of *R. ichthyoides* Leeuwenb., *R. ichthyoides* subsp. *bracteata*. The authors failed to include a Latin description, therefore the name was not validly published (McNeill et al., 2006). Consequently, the combination based on the subspecies name, published by Fernández-Alonso (2006), was also not validly published. To rectify the situation and finally validate the new taxon, we present here a Latin diagnosis and recognize the subspecies at the rank of species.

Resia bracteata is different from all other congeners by the presence of inflorescence bracts. The absence of bracts in all other species of *Resia* was an important character that was emphasized for the classification of this genus in the tribe Beslerieae (Wiehler, 1983; Skog & de Jesus, 1997). All members of Napeantheae are characterized by the presence of inflorescence bracts, and all members of the tribe Beslerieae are characterized by the absence of inflorescence bracts. The tribal placement of *Resia* needs to be reconsidered, and fieldwork in Colombia or Venezuela to collect leaf material for molecular systematic studies will help resolve the tribal placement of this enigmatic genus. *Resia* is one of three genera (the other two are *Lampadaria* Feuillet & L. E. Skog in the Episcieae and *Cremospermopsis*

L. E. Skog & L. P. Kvist in the Beslerieae) in the New World Gesneriaceae that has not yet been evaluated using molecular sequence data.

Additional vegetative characters are also useful for differentiating *Resia bracteata* from *R. ichthyoides*. *Resia bracteata* has chartaceous leaves with prominent tertiary venation and bullate leaf surfaces. In contrast, *R. ichthyoides* has membranous leaves with suppressed tertiary venation and non-bullate leaf surfaces (Fernández-Alonso, 2006).

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Nogopterium, a New Name for the Genus *Pterogonium* (Musci, Leucodontaceae)

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ABSTRACT. *Pterogonium* Sw. (Leucodontaceae), a long-used, illegitimate name for what is probably a unispecific genus of mosses, is replaced with an anagram, *Nogopterium* Crosby & W. R. Buck. The needed new combinations, *N. gracile* (Hedw.) Crosby & W. R. Buck and *N. beyrichianum* (Hampe) Crosby & W. R. Buck, are made.

Key words: illegitimate homonym, Leucodontaceae, *Nogopterium*, *Pterogonium*.

Pterogonium Sw. (Anonymous, 1801) was published as a substitute name for *Pterigynandrum* Hedw. (1801) and is illegitimate (Brummitt, 2002; McNeill et al., 2006: Art. 52.1, 2). Swartz (1798) published *Pterogonium* in a pre-starting point publication, with valid publication of names in the Musci after January 1, 1801 (McNeil et al., 2006: Art. 13.1[b]). An anonymous reviewer of Swartz's publication validated many of its names, reproducing Swartz's earlier Tabula Generum and indicating Hedwig's generic names parenthetically, using the initial "H" to indicate Hedwig, thus "*Pterogonium* (*Pterigynandrum*. H.)" (Anonymous, 1801: 537).

Pterogonium has been incorrectly used since ca. 1855 (e.g., Schimper, 1855) for a genus of Leucodontaceae of one well-known species, treated as *P. gracile* (Hedw.) Sm., and two poorly known ones (see Crosby et al., 2000). No generic name is available for this small group, which probably constitutes only a single species of moss. The following new generic name, to be pronounced no-gop-tér-i-um, is validated under Article 32.1(d) of the Vienna Code (McNeill et al., 2006: 58) by "reference to a previously and effectively published description." It is an anagram of *Pterogonium*.

Nogopterium Crosby & W. R. Buck, nom. nov., pro *Ptergonium* sensu Schimp., Syn. Musc. Eur., ed. 2, 575. 1876. TYPE: *Pterigynandrum gracile* Hedw. [= *Nogopterium gracile* (Hedw.) Crosby & W. R. Buck].

Two names at the rank of species are accepted for the genus.

1. **Nogopterium beyrichianum** (Hampe) Crosby & W. R. Buck, comb. nov. Basionym: *Pterogonium beyrichianum* Hampe, Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn, ser. 4, 1: 127. 1879. TYPE: [Brazil:] "Prope Novo Friburgo ad ramos legit Beyrich," s.d., s. coll. (type, BM not seen).

2. **Nogopterium gracile** (Hedw.) Crosby & W. R. Buck, comb. nov. Basionym: *Pterigynandrum gracile* Hedw., Sp. Musc. Frond. 80. 1801. *Hypnum gracile* (Hedw.) With., Syst. Arr. Brit. Pl., ed. 4, 3: 842. 1801. *Grimmia gracilis* (Hedw.) F. Weber & D. Mohr, Index Mus. Pl. Crypt. [2]. 1803. *Pterogonium gracile* (Hedw.) Sm., Engl. Bot. 16: 1085. 1803. *Maschalocarpus gracilis* (Hedw.) Spreng., Syst. Veg. 4(1): 158. 1827. *Leptohymenium gracile* (Hedw.) Huebener, Muscol. Germ. 554. 1833. *Anomodon gracilis* (Hedw.) Garov., Bryol. Austr. Excurs. 46. 1840. *Neckera gracilis* (Hedw.) Müll. Hal., Syn. Musc. Frond. 2: 97. 1850. TYPE: [United Kingdom.] "Anglia et Scotia prope Edinburg: etiam in saxis legisse Brewerum Dillenius habet" (lectotype, designated by Hedenäs & Geissler [1999: 430], "e Dillenii herbario," G not seen).

The third species, *Pterogonium peregrinum* Schimp. (Jardin, 1875: 264) is noted from the protologue as [California:] "San-Francisco," for an É. Jardin coll., with an isotype seen at NY. The name appears on p. 264 and [the diagnosis on p. 266] is a synonym of *Isothecium cristatum* (Hampe) H. Rob. (Anderson et al., 1990).

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A New Species of *Pachycarpus* (Apocynaceae: Asclepiadoideae) from KwaZulu-Natal, South Africa

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Abstract. *Pachycarpus acidostelma* M. Glen & Nicholas (Apocynaceae, Asclepiadoideae) is a new species described from the KwaZulu-Natal Province of South Africa. The new taxon is differentiated from other closely related *Pachycarpus* E. Mey. species (*P. scaber* (Harv.) N. E. Br. and *P. asperifolius* Meisn.) by its small stature, the catilliform or saucer-shaped corolla, and a deltoid corona lobe that is sharp at the distal end, hence the specific epithet. It also differs from *P. asperifolius* in the inflorescence being terminal and subcorymbose.

Key words: Apocynaceae, Asclepiadoideae, IUCN Red List, *Pachycarpus*, South Africa.

During recent fieldwork undertaken at Highflats in the South African province of KwaZulu-Natal, one of the authors (Shuttleworth) collected two specimens of *Pachycarpus* E. Mey. that could not be placed into any previously known species of this genus. Preliminary assessments of these collections suggested that they may be allied to *P. asperifolius* Meisn. or *P. scaber* (Harv.) N. E. Br. Analyses of morphological data, however, suggest that the Highflats population is a distinct entity, more similar to *P. scaber* than to *P. asperifolius* (Figs. 1, 2). Although the distributions of all three species are sympatric at a provincial level, neither *P. scaber* nor *P. asperifolius* have yet been seen or collected in or near the vicinity of the new species. Based on these findings, it was decided that the Highflats *Pachycarpus* population, although of restricted distribution, is deserving of recognition at species level.

The genus *Pachycarpus* (Apocynaceae, Asclepiadoideae) was taxonomically recognized by N. E. Brown (1902, 1908) and currently comprises 44 taxa throughout Africa (Goyder, 1998). Thirty of these taxa occur in southern Africa, 90% of which are endemic to this region (Smith, 1988). Excluding the taxa within section *Trichocodon* D. M. N. Sm. (Smith, 1988), the rest of the genus is morphologically well correlated in southern Africa with many common correlated diagnostic characters (Nicholas, 1999). These include deep-seated, cylindrical rootstock, stout stems with a large pith, broad leaves, inflorescences lateral at the nodes, rarely terminal, stout peduncles (when present), flowers not causing the stems to droop, smooth carpels, and fruits that are leathery and inflated in many species.

Pachycarpus acidostelma M. Glen & Nicholas, sp. nov. TYPE: South Africa. KwaZulu-Natal Prov.: Ixopo Distr., 1 km SSE from Highflats, 3 Dec. 2007, *A. Shuttleworth 38* (holotype, NU; isotype, MO). Figures 1A, C, 3.

Haec species *Pachycarpo scabro* (Harv.) N. E. Br. et *P. asperifolio* Meisn. affinis, sed a hoc inflorescentia corymbosa subcorymbosave atque columna staminali plerumque breviore, ab ambobus statura humiliore, corolla juveni catilliformi atque coronae lobo distaliter deltoideo acuto differt.

Habit erect, perennial geophytic herb with milky latex. Rootstock deep-seated, narrow, cylindrical caudex. Stems mostly solitary, 37–40 cm tall, slightly scabrid. Leaves oval, oblong and wide, 3.8–7.9 × 2–3.4 cm; apex obtuse or rounded with slight mucronate point; base shortly attenuate, rounded; margin thickened, callose and sparsely ciliate, occasionally almost revolute; vestiture glabrous, with the abaxial midrib hispid; venation prominent on the underside; petioles 3–6.5 mm. Inflorescences terminal and extra-axillary, 4 per stem, corymbose or subcorymbose; 4- to 6-flowered; peduncles free, 11–29 mm; pedicels pubescent, 15–21 mm. Flowers pale cream to pale yellow, sweetly scented, 13–17 × 23–25 mm; sepals reflexed, scabrid, 7.5–9 × 3.5–6.5 mm; corolla cream, spreading and catilliform when young, tips reflexed when mature; lobes ovate, ca. 9–12 × 9 mm; gynostegial column 3.9–4.8 mm tall; corona cream, tinged yellow at base; lobes spreading 1.4–3.2 × 1.7–2.4 mm, 2.5–2.7 mm tall, proximal end broad with two curved, erect, contiguous, dentate appendages,

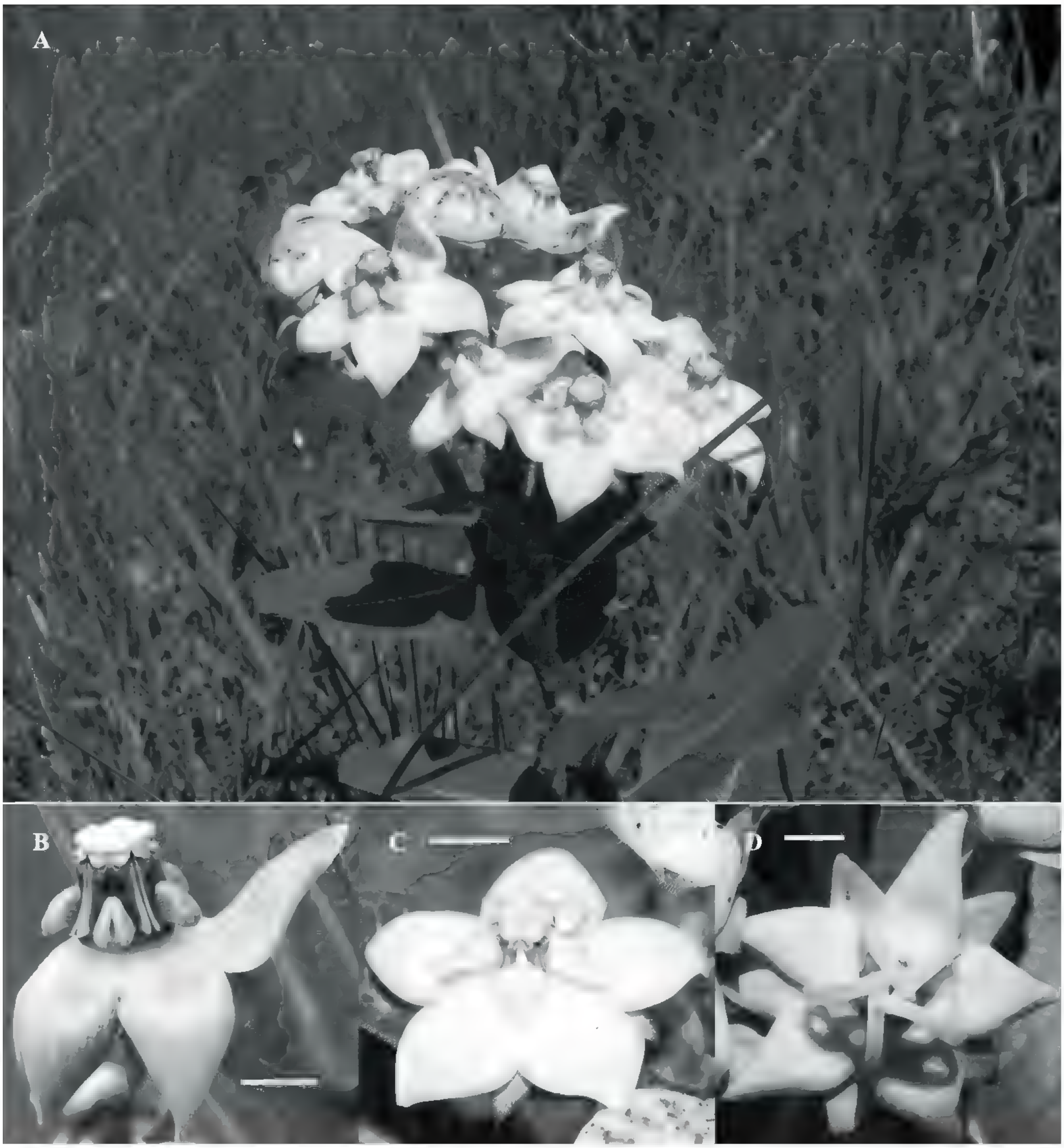

Figure 1. —A. *Pachycarpus acidostelma* M. Glen & Nicholas. Flowering branch (photo by A. Shuttleworth [from the type population, but not of type specimen]). —B. *P. asperifolius* Meisn. Flower with tall staminal columns and smaller corona lobes (photo by P. Wragg). —C. *P. acidostelma*. Flower with deltoid corona lobes (photo by A. Shuttleworth [not of type specimen]). —D. *P. scaber* (Harv.) N. E. Br. Flower with long corona lobe appendages (photo by M. Glen [*M. Glen & W. Froneman 106*, UDW]). B–D scale bars = 5 mm.

broadening distally into a sharp deltoid point (2–2.7 × 0.7–1.9 mm) with sharp apex, a shallow groove running along the upper surface and between the proximal appendages; androecium, with the anther appendages oblong with acute apex, ca. 2 × 1.7–2 mm; anther wings moderately prominent, 2.4–3.4 × 1–1.4 mm; pollinarium, with the corpusculum ca. 0.75–0.85 × 0.45 mm; translator arm narrowly winged, 0.9–1.4 mm; pollinium dorsoventrally flattened, oblong, 1.35–1.8 × 0.65–0.9 mm; gynoecium with style head 3.3–3.7 mm diam. Fruit a follicle, solitary, on bent pedicel, inflated, ovoid, ca. 90 × 34 mm, winged apically; apex angular; seeds not seen.

Etymology. The epithet for the new species refers to its sharply pointed corona lobes.

Distribution and habitat. *Pachycarpus acidostelma* is only known from one locality near Highflats in KwaZulu-Natal. It grows in midland grasslands at an altitude of between 960 and 976 m.s.m.

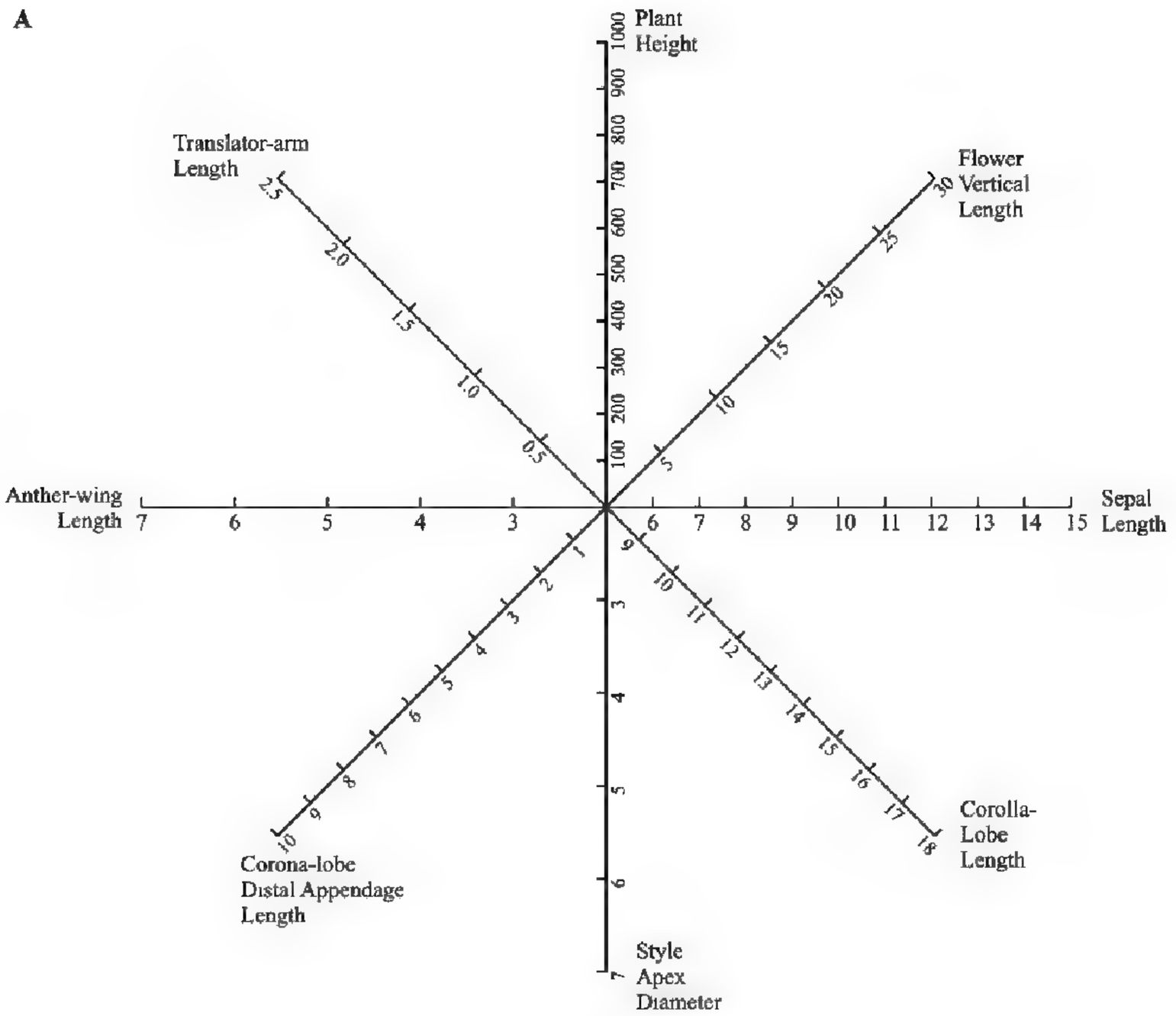

Figure 2. —A. Eight-dimensional polygonal graph illustrating relationships among plant height, flower vertical length, sepal length, corolla lobe length, style apex diameter, distal corona lobe appendage length, anther wing length, and translator arm length. Mapped morphological states (mm) for B, *Pachycarpus asperifolius*; C, *P. acidostelma*; and D, *P. scaber*. Specimens from which data were collected: ***P. asperifolius*:** *A. Abbott 703* (NH), *A. & G. Hutchings & E. Plumstead 2054* (NH), *A. M. Ngwenya 458* (NH), *N. Nombekela 458* (NH), *D. Harriss 50*, *77*, and *112* (NU), *J. L. Gordon-Gray 1003* (NU), *K. Balkwill & M.-J. Cadman 2139* (NU), *R. G. Strey 6151* (NU), *T. Edwards 354* (NU), *A. Nicholas, L. Smook & E. Harrison 2352* (PRE), *E. E. Galpin 3195* and *3445* (PRE), *R. G. Strey 9304* (PRE), *C. J. Ward 6380*, *6380a*, and *12800* (UDW), *E. Hennessy 214* (UDW), *J. E. Rzepecke 89a* and *89c* (UDW). ***P. scaber*:** *A. Nicholas & N. van den Berg 1762* (NH), *D. Green 475* (NH), *G. Thorncroft 433* (NH), *J. M. Wood 448* (NH), *R. H. Compton 31773* (NH), *T. R. Greene 816* (NH), *M. L. Jacobsz 1774* (PRE), *R. Pott 4897* (PRE), *S. P. Bester 3909* (PRE), *S. R. Hobson 2161* (PRE), *N. L. Meyer 110* (PRU). ***P. acidostelma*:** *A. Shuttleworth 38* and *39* (NU), *N. E. Shirley 328* (NU).

Ecology. *Pachycarpus acidostelma* is known from a single locality in KwaZulu-Natal sandstone sourveld (vegetation classification sensu Mucina & Rutherford, 2006). The limited floral visitor observations conducted to date suggest that *P. acidostelma* is specialized for pollination by the chafer beetle *Atrichelaphinis tigrina* (Olivier, 1789) and attaches pollinaria to the tarsi of these beetles (Shuttleworth & Johnson, 2009). Flowers were also visited by various flies, although these were not observed to carry pollinaria and are unlikely to contribute to pollination (Shuttleworth & Johnson, 2009). The flowers of this species have a faint, sweet scent to the human nose. Chemical analysis showed the scent to be dominated by aliphatic compounds and common floral monoterpenes such as linalool, (E)- and (Z)-ocimene, limonene, and myrcene, several of which are also produced by other chafer-pollinated asclepiads (Shuttleworth & Johnson, 2010). A more in-depth study of this species' pollinator requirements and breeding system is essential for long-term conservation planning measures.

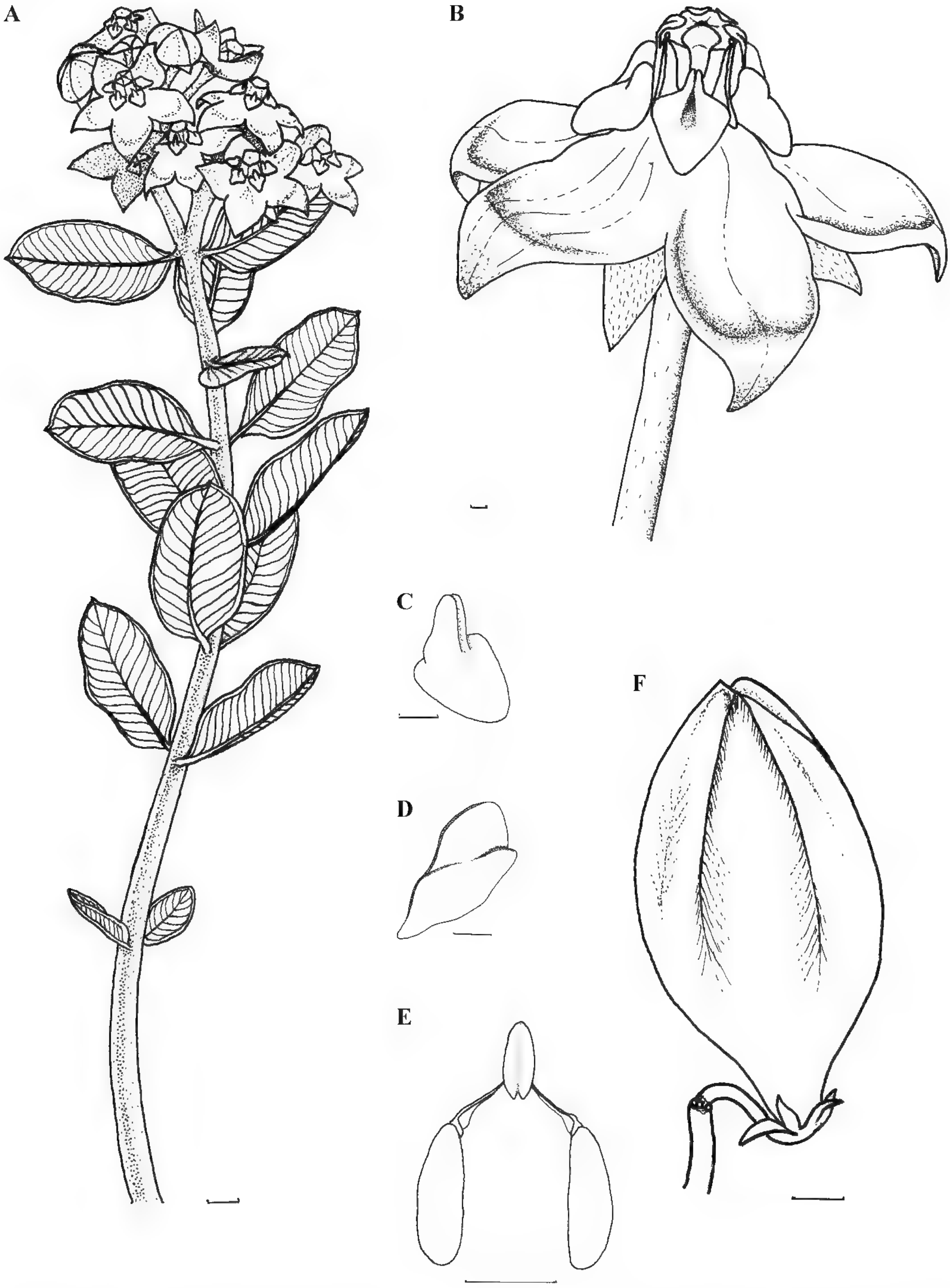

Figure 3. *Pachycarpus acidostelma* M. Glen & Nicholas. —A. Flowering stem. —B. Lateral view of intact flower. —C. Oblique view of corona lobes. —D. Lateral view of corona lobes. —E. Pollinarium. —F. Fruit. Scale bars: A, F — 1 cm; B–E — 1 mm. Drawn by M. Glen from *A. Shuttleworth 38* and *39* (NU) and *N. E. Shirley 328* (NU).

IUCN Red List category. *Pachycarpus acidostelma* is considered a Critically Endangered taxon, according to IUCN (2001) criteria (CR B2ab(iii); D). This species is only known from one population containing ca. 40 mature individuals. It is extremely restricted in distribution (< 10 km^2), surrounded by extensive farming and increasing human populations. The future conservation of this species relies

Table 1. Comparison between different diagnostic morphological characters for *Pachycarpus acidostelma*, *P. asperifolius*, and *P. scaber*.

Species	*P. acidostelma*	*P. asperifolius*	*P. scaber*
Average plant height (cm)	39	57	55
Leaf shape	broadly oblong	elliptic	ovate
Leaf apex	obtuse with mucronate point	acute-acuminate	rounded-abruptly acute
Inflorescence type	subcorymbose	racemose	corymbose
Flower color	pale cream to pale yellow	pale green with mauve	cream-pale yellow
Corolla shape	catilliform	reflexed	spreading
Corona lobe shape	deltoid	globular	with filiform distal appendage that is connivent over stigma-style apex
Corona lobes proximal, lateral auricles presence	absent	absent	present
Average gynostegial column height (mm)	4.35	6.65	4.61
Follicle shape	ovoid and winged apically	ellipsoid and winged longitudinally	globose and shallowly winged longitudinally

on its official recognition and inclusion on Red Data lists.

Discussion. The corona lobes of *Pachycarpus acidostelma* are somewhat similar in structure to those of *P. asperifolius*, with the result that one specimen (*Shirley 328*, NU) has previously been erroneously named and filed under this latter species. *Pachycarpus acidostelma* differs from *P. asperifolius* and *P. scaber* in a number of important morphological traits (Table 1, Fig. 1).

Key to *Pachycarpus acidostelma* and Allies in South Africa

1a. Inflorescences racemose; flowers at different heights along flowering stem; staminal column 5–13.5 mm tall ..... *P. asperifolius*
1b. Inflorescences corymbose or subcorymbose, flowers held at almost the same level at or near the terminus of the flowering stem; staminal column 2.3–7.5 mm tall 2
2a. Distal corona lobe with filiform appendage 5.6–10.5 mm long, recurving and connivent over the style-stigma head ..... *P. scaber*
2b. Distal corona lobe without an appendage, the lobe tapering horizontally to a sharp deltoid point ..... *P. acidostelma*

Paratypes. SOUTH AFRICA. **KwaZulu-Natal:** Highflats, 20 Oct. 1964, *N. E. Shirley 328* (NU); 17 Jan. 2008, *A. Shuttleworth 39* (NU, PRE).

Acknowledgments. The authors thank the Walker family for allowing fieldwork to be undertaken on their farm in Highflats; Peter Wragg for the use of his photograph; and the National Research Foundation (NRF), South African Association of Botanists (SAAB), and Wildlife and Environment Society of South Africa (WESSA) for funding this project. We thank the following herbaria for the loan of material: NH, NU, PRE, and PRU.

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Arum cylindraceum subsp. *pitsyllianum* (Araceae), a New Taxon from Cyprus

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ABSTRACT. *Arum cylindraceum* Gasp. subsp. *pitsyllianum* Hadjik., Hand & G. Mans. (Araceae), a rare Cypriot endemic, is described as new. This diploid taxon differs from *A. cylindraceum* s. str. by the spathe tube that is whitish to greenish white internally with a pale purple horizontal strip just above the base and 3–4 cm long, the spadix, which is orange to orangish purple, and the anthers and connectives that are orange.

Key words: Araceae, *Arum*, Cyprus, IUCN Red List.

According to Boyce (1993, 2006), the genus *Arum* L. consists of 28 species, occurring from the Azores, North Africa, Europe, and eastward to China. *Arum megobrebi* Lobin, M. Neumann, Bogner & P. C. Boyce, an additional taxon, has been described recently (Lobin et al., 2007). The genus is represented in Cyprus by six species placed in various infragenera (cf. Boyce, 1993, 1994, 2006) and includes *A. italicum* Mill., *A. concinnatum* Schott (section *Arum*), *A. sintenisii* (Engl.) P. C. Boyce (section *Dioscoridea* P. C. Boyce subsection *Dischroochiton* Schott), *A. rupicola* Boiss. (section *Dioscoridea* subsection *Tenuifila* (Engl.) P. C. Boyce), *A. hygrophilum* Boiss. (section *Dioscoridea* subsection *Hygrophila* P. C. Boyce), and *A. dioscoridis* Sm. (section *Dioscoridea* subsection *Poeciloporphyochiton* Schott). Both the new subspecies and *A. cylindraceum* Gasp. would assign to *Arum* sect. *Dioscoridea* subsect. *Alpina* P. C. Boyce. Recent molecular phylogenies of the genus are partially congruent with the morphological classification (Mansion et al., 2008; Espíndola et al., 2010; Linz et al., 2010), which suggests extreme caution when proposing a new classification without identifying nonmolecular synapomorphies.

In 1996, *Arum* specimens were collected by the first author from Madari Peak in Cyprus, and the same taxon was later found in the vicinity of Lagoudera village. Although it exhibited characters of *A. cylindraceum*, the Cypriot plants differed in several details. Correspondence and two photographs of the plant (one showing the open spathe with spadix, and one showing the leaf blade) were sent to Peter Boyce (pers. comm., 2004), who confirmed the determination and stated: "This is a new record for Cyprus (indeed a new record so far east in the Mediterranean)—the nearest population in the Mediterranean is Crete, although there are isolated populations in continental West Turkey." Since then, new populations have been found in Cyprus and afford a broader view.

So far, the taxonomy of *Arum cylindraceum* does not appear to be fully clarified. This is suggested by the fact that the two taxa *A. cylindraceum* (earlier treated under the synonym *A. alpinum* Schott & Kotschy) and *A. lucanum* Cavara & Grande, first accepted by Boyce (1993), were later classified together (Boyce, 2006). As regards the latter taxon, Boyce (2006: 134) stated that "without a shadow of doubt...it too is referable to the prioritized *A. cylindraceum*." This is somewhat surprising, for the two taxa were originally placed in two different subsections, with *A. lucanum* assigned to subsection *Dischroochiton* Schott and *A. cylindraceum* (= *A. alpinum*) to subsection *Alpina*. The synonymy of these names is currently generally accepted (see Bedalov & Küpfer, 2005, for taxonomic concepts), but a recent molecular study by Linz et al. (2010: 413) found that the two taxa "did not form a group." The study by Espíndola et al. (2010: 27) indicated that even *A. cylindraceum* s. str., as a taxon that excluded *lucanum*, may be paraphyletic. They recommend that "future taxonomic revisions should carefully consider characters not related to pollination" because of probable convergent evolution.

Material and Methods

Extensive research has been carried out in the field, taking into consideration all known populations of the new taxon. Plants collected in the field were

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also cultivated in the Botanical Garden Berlin–Dahlem for further morphological, karyological, and molecular investigations. Chromosome counts were performed on three different specimens found in two field localities (indicated by asterisks among the Paratypes listed in this article), following the methodology described by Vogt and Aparicio (2000).

Results

Morphological Study

No taxon of the genus other than *Arum cylindraceum* shows the same combination of key characters such as the discoid tuber, the more or less greenish-colored inner surface of the ovate spathe limb, the filiform staminode and pistillode bristles, the slender clavate spadix, and the spring flowering. A close inspection of specimen characters in the field, in cultivated plants, and in herbarium material revealed that the plants from Cyprus differ slightly from *A. cylindraceum* in certain consistent characters, which together provide sufficient evidence to treat the new taxon as a geographically isolated subspecies.

Chromosome number. All counts revealed $2n = 28$, a diploid number within the genus.

Taxonomic Treatment

1. Arum cylindraceum Gasp., Fl. Sic. Prodr. 2(2): 597. 1844. *Arum italicum* var. *cylindraceum* (Gasp.) Nyman, Consp. Fl. Eur. 755. 1882. TYPE: [Italy] "in herbosis montosis; Madonie al piano della battaglia di petralis," s.d., *Gasparrini s.n.* (type, FI, cf. Boyce, 1993).

1a. Arum cylindraceum subsp. **pitsyllianum** Hadjik., Hand & G. Mans., subsp. nov. TYPE: Cyprus. Div. 2 (sensu Meikle, 1977), Troodos mtn. range, above Lagoudera, Pitsyllia area, Lefkosia district, under *Corylus* sp., ca. 1200 m, 30 May 2009, *G. Hadjikyriakou 7070* (holotype, B; isotypes, B, CYP, MO, Hb. Hadjikyriakou). Figure 1.

Subspecies nova quae ab *Aro cylindraceo* Gasp. subsp. *cylindraceo* tubo spathae 3 4 cm (non 2 3 cm) longo, appendice spadicis aurantiaca vel aurantiaco-purpurea (non fusca vel atropurpurea) atque antheris aurantiacis (non purpureis) differt.

Tuberous herb, sprouting in late winter, February to March; tuber discoid, vertically, sometimes horizontally oriented, 2–4 × 1.5–3 cm. Petiole, including the sheath 15–30(–38) cm × 3–5 mm, canaliculate above, semicircular below, dark to light green, sometimes stained purple along the sheath margin and at the base of the petiole. Leaf blade constantly sagittate, apex acute to subacute, 6–15 × 4–10 cm, dark to light green; basal lobes overlapping at the lower, inner side in younger leaves. Inflorescence unscented; peduncle from above the tuber 13–30(–39) cm × 2–7 mm, usually shorter, but sometimes equal to or longer than the petioles, terete, deep to open green; spathe 9–16 cm; spathe tube 30–40 mm, ± ovate, constricted above, externally pale to yellowish green, without purple stains at the base, but sometimes present along the margins, interior whitish to greenish white, with a pale purple horizontal strip just above the base, up to 1 cm wide or with a few traces of the strip visible; spathe limb ovate-lanceolate, up to 12 × 6 cm, erect or slightly cucullate, acuminate, pale to yellowish green externally, sometimes purple tinged along the margins, internally pale to yellowish green, with or without purple margins; spadix not more than 1/2 to 3/4 the length of the spathe, limp, 5.4–7.5 cm in total length, the floral groups lying close to each other or with a very short space in between; spadix appendix and stipe clavate, evenly tapering toward stipe, 30–40 × 1.5–5 mm, appendix up to ca. 10% wider than stipe, appendix orange to orangish purple, the stipe yellow, sometimes dirty yellowish purple. Staminodes usually in 3 whorls, forming a zone 3–5 mm wide, bristles filiform, slightly flexuous to semirigid, constantly pointing downward, rarely a few nearly horizontal, 5–6 mm long, creamy white all over, bases conic, verrucate, creamy. Staminate flowers forming a zone 4–6 mm wide, anthers and connectives orange. Pistillodes mostly in 2 to 3 whorls forming a zone of about 5 mm wide, bristles filiform, rigid to semirigid, mostly pointing upward, creamy white, bases bulbiform, creamy white. Pistillate flowers in a cylindrical cluster 10–12 mm long, ovaries spherical, greenish yellow, stigma brownish. Fruiting spike oblong-cylindrical, 3–4 cm long, ca. 2.5 cm wide; berries somewhat angular to irregularly shaped, (6–)7.5–9(–10) × 5–7(–10) mm, red to reddish orange; seeds 1 per fruit, broadly elliptic to globose, pale brown, net-veined to pitted, 4–7 × (3.5–)4–5.5 mm.

Phenology. *Arum cylindraceum* subsp. *pitsyllianum* was observed to flower from May to the beginning of June.

Etymology. The Pitsyllia area is located in the central to eastern part of the Troodos mountain range, which extends from the Platania forest station to the western slopes of Machairas Peak, at altitudes between 500 and 1600 m. The epithet of the new

Figure 1. *Arum cylindraceum* subsp. *pitsyllianum* Hadjik., Hand & G. Mans. —A. Habit of flowering plant. —B. Tuber. —C. Inflorescence with partially removed spathe. —D. Infructescence. Photographs in A, B, and D by G. Hadjikyriakou: A, 7 May 2010, above Lagoudera; B, 30 May 2009, above Lagoudera; D, July 2002, Madari. Photograph in C by C. S. Christodoulou, 28 May 2009, Papoutsa.

subspecies is attributed to the Pitsyllia site, because investigations so far have shown that the taxon is restricted to that landscape.

Distribution and ecology. *Arum cylindraceum* subsp. *pitsyllianum* was first collected in the environs of Madari Peak (1450–1580 m in altitude) on scree slopes and under *Quercus alnifolia* Poech. At a later stage it was located in *Corylus* L. groves in the environs of Lagoudera village (ca. 1200 m). In 2009, the new taxon was found on Papoutsa Peak (1350–1550 m), about 9 km southeast of Madari, on rocky

places under *Q. alnifolia* (C. S. Christodoulou, pers. comm.). At the Madari and Papoutsa sites where *Q. alnifolia* forms more or less dense stands on rocky screes, the new *Arum* taxon was associated with the following shrubs: *Rosa chionistrae* H. Lindb., *Cotoneaster nummularius* Fisch. & C. A. Mey., *Juniperus excelsa* M. Bieb. subsp. *excelsa*, *Lonicera etrusca* Santi, and *Berberis cretica* L. The herbal layer consisted of, e.g., *Nepeta troodi* Holmboe, *Pterocephalus multiflorus* Poech subsp. *multiflorus*, *Galium aparine* L., *Geranium lucidum* L., *Geranium purpureum* (L.) Vill., *Ornithogalum chionophilum* Holmboe, *Paeonia mascula* (L.) Mill. subsp. *mascula*, *Poa bulbosa* L., *Anthemis plutonia* Meikle, *Arabis purpurea* Sm., and *Smyrnium rotundifolium* Mill. Vegetation of the *Corylus* orchards differed considerably. The shady stands of *C. avellana* L. and *C. maxima* Mill. show a very dense herbal layer comprised of *Alliaria petiolata* (M. Bieb.) Cavara & Grande, the rare *Epipactis microphylla* (Ehrh.) Sw., *Platanthera chlorantha* subsp. *holmboei* (H. Lindb.) J. J. Wood, *Smyrnium rotundifolium* Mill., *Rubus sanctus* Schreb., *Cyclamen cyprium* Kotschy, and *Viola odorata* L. The geological substratum belongs to the Troodos ophiolite complex, and the dominant rock type at Madari and Papoutsa peaks is composed of diabase dikes, whereas that of Lagoudera is composed of gabbro (Geological Survey Department [Cyprus], 1995).

IUCN Red List category. *Arum cylindraceum* subsp. *pitsyllianum* is a rare endemic taxon. The most serious threats are forest fires, agricultural activities, forestry, trampling, and road construction. According to IUCN (2001) criteria, the subspecies should be categorized as Endangered (EN) B1ac(ii–iv) + 2ac(ii–iv). This indicates that the extent of occurrence and the area of occupancy are severely fragmented and there are extreme fluctuations in the area of occupancy, the number of locations or subpopulations, and the number of mature individuals. The populations at Madari and Papoutsa were found within a proposed Natura 2000 site, and a habitat type of 9390 (*Quercus alnifolia* arborescent matoral; for further information on sites and habitat type categories, see European Environment Agency, 2011) is of priority. The population at Madari is found in the Adelfoi Main State Forest.

Discussion. Our study showed that the new taxon from Cyprus combines a set of characters that has not been found in any other population of *Arum cylindraceum*, a species that has been dealt with in great detail in the monograph by Boyce (1993). Because of the particular geographical distribution and morphological features—and being well aware of the variability of *A. cylindraceum*—we rank the new taxon as subspecies replacing the typical subspecies in Cyprus, the easternmost Mediterranean island. We refrain from ranking the new taxon as at the species level because a number of qualitatively important characters are still present with *A. cylindraceum* (cf. Table 1).

Morphologically, both entities share a number of features such as the discoid tuber, the more or less clavate spadix appendix, similar coloration patterns of spathe, and the filiform staminode and pistillode bristles. Furthermore, cytological investigations support an identical, diploid, chromosome number for both taxa (Bedalov & Küpfer, 2005; Lendel et al., 2006).

The Cyprus taxon differs from the typical subspecies by the spathe tube, which is whitish to greenish white internally, with a pale purple horizontal strip just above the base, up to 1 cm wide or with a few traces of the strip visible (no strip in *Arum cylindraceum* subsp. *cylindraceum*). The spadix appendix is orange to orangish purple (vs. chocolate-brown to dark purple), and the anthers and connectives are orange (vs. purple and yellow). Furthermore, the new subspecies is a late winter sprouting plant, in comparison to earlier growth, autumn to early winter in the typical subspecies (cf. Table 1).

Recent phylogenetic studies (Mansion et al., 2008; Linz et al., 2010) support an *Arum cylindraceum* clade that included *A. apulum* (Carano) P. C. Boyce, *A. balansanum* R. R. Mill, *A. cyrenaicum* Hruby, *A. euxinum* R. R. Mill, *A. longispathum* Rchb., *A. purpureospathum* P. C. Boyce, along with the two subspecies of *A. cylindraceum* Gasp. (Mansion & Hand, unpublished). It is noteworthy that except for the new subspecies, no other members of the *A. cylindraceum* clade occur in Cyprus. In this island, the remaining species of *Arum* belong to different infragenera (cf. key for Greece and Cyprus by Boyce, 1994). The new taxon now replaces determinations of *A. cylindraceum* in Cyprus, and we treat it as a geographic vicariant at the rank of subspecies. The occurrences of the new subspecies in Cyprus are the easternmost for its distributional area; *A. cylindraceum* is known to occur from Spain to the Balkans and from Sweden to Crete and northwest Turkey at altitudes to 2000 m (Boyce, 1993). The map presented by Boyce (1993) and reprinted by Linz et al. (2010) is not fully convincing, at least regarding central Europe and parts of western Europe. In Germany (shown as part of the area) *A. cylindraceum* is not native, but is instead a very local established

Table 1. Morphological comparison of *Arum cylindraceum* Gasp. subsp. *pitsyllianum* Hadjik., Hand & G. Mans. and subspecies *cylindraceum*. Diagnostic differences for the newly described subspecies *pitsyllianum* are emphasized in boldface. The typic subspecies is considered in the broad sense, including *A. alpinum* Schott & Kotschy and *A. lucanum* Cavara & Grande in synonymy.

Taxon	*A. cylindraceum* subsp. ***pitsyllianum***	*A. cylindraceum* subsp. *cylindraceum**
Sprouting	**late winter**	autumn to early winter
Petiole, including sheath	canaliculate above, semicircular below, 15–30(−38) cm	terete, (6–)12–18(−23) cm
Leaf blade	consistently sagittate, 6–15 cm	sagittate to sagittate-hastate or ovate-cordate, 6–13 cm
Inflorescence odor	unscented	unscented or smelling weakly of dung
Peduncle length, from above the tuber	13–30(−39) cm × 2–7 mm, usually shorter, but sometimes equal to or longer than the petioles	shorter, equal to, or exceeding the petioles, 10–18 cm
Spathe tube	**3–4 cm, constricted above, internally whitish to greenish white, with a pale purple horizontal strip just above the base, up to 1 cm wide or with a few traces of the strip visible**	2–3 cm, moderately to barely constricted apically, internally the basal 1/3 very pale greenish white, the upper 2/3 purple or totally greenish white
Floral groups	lying close to each other or with a very short space in between	usually separated, with longer intervals between (see Galán & Castroviejo, 2007: pl. 83; Boyce, 1993: 88, pl. 4)
Spadix	5.4–7.5 cm	4–8 cm
Spadix appendix and stipe	clavate, apically slightly thicker, evenly tapering toward stipe, 30–40 × 1.5–5 mm, **appendix orange to orangish purple,** the stipe yellow, sometimes dirty yellowish purple	slender and cylindric, slightly to moderately clavate, long-stipitate, 20–50 × 2–4 mm, appendix pale chocolate-brown to dark purple, stipe fading to cream basally
Staminode whorls	3	2 to 6
Staminode bristles	filiform, slightly flexuous to semirigid, **pointing downward**, rarely a few nearly horizontal, 5–6 mm, creamy-white throughout	filiform, semirigid or filiform flexuous, 3–6 mm, position variable, some pointing upward, some horizontal, and some pointing downward (e.g., Galán & Castroviejo, 2007: pl. 83; Boyce, 1993: 88, pl. 4), cream or cream-tipped with purple
Staminate flowers	**anthers and connectives orange**	purple or anthers purple, connectives yellow (Boyce, 1993: pl. 4; Fielding & Turland, 2005: 464)
Pistillodes	mostly in 2 or 3 whorls	in 2 to 5 whorls
Pistillode bristles	filiform, rigid to semirigid, mostly oriented upward, creamy white	aristate, semirigid to filiform, flexuous, cream or cream-tipped with purple
Pistillate flowers	in a cylindrical cluster 10–12 mm, ovaries spherical	in a globose or an oblong-cylindrical cluster 4–20 mm, ovaries oblong or oblong-cylindrical to oblong-globose

*The values represent the merged details given for *A. alpinum* and *A. lucanum* in Boyce (1993).

alien in the northernmost part of the country (Jäger & Werner, 2005). In Austria, the nominal subspecies is restricted to the easternmost parts of the country and Carinthia (Fischer et al., 2008), whereas Bedalov and Küpfer (2005) stated that it is found only in southeast France.

It seems likely that populations of the *Arum cylindraceum* clade in Cyprus were isolated some time ago and are currently speciating through relictual isolation. Nonetheless, as stated by Espíndola et al. (2010), morphological characters referring to pollination syndromes can evolve quite rapidly in *Arum*, and no definitive conclusion on the origin of the new subspecies can be inferred without rigorous biogeographic studies.

Paratypes. CYPRUS. **Madari:** 19 May 1996, *G. Hadjikyriakou 1827* (Hb. Hadjikyriakou); 22 May 1999, *Hadjikyriakou 4550* (Hb. Hadjikyriakou); 22 May 2002, *Hadjikyriakou 5422* (Hb. Hadjikyriakou); Chandria, Madari, along descending path below Adelfoi summit, 20 May 2005, **Hand 5039 & Hadjikyriakou* (B, B EtOH coll., B cult. acc. 153-04-05-20, cult. until 6 May 2008), *Cubr 45408* (B); above Lagoudera, 22 May 1999, *Hadjikyriakou 4542* (Hb. Hadjikyriakou); 25 May 2002, *Hadjikyriakou 5420* (Hb. Hadjikyriakou); 7 Mar. 2004, *Hadjikyriakou*

5928 (Hb. Hadjikyriakou); Lagoudera, below Polystipos jct., in a conspicuous rd. bend, 20 May 2005, **Hand 5036 & Hadjikyriakou* (B [2], B cult. acc. 153-05-05-20), *Cubr 46993* (B).

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Lectotypification and Reinstatement of *Stachytarpheta friedrichsthalii* (Verbenaceae), with Notes on the Lectotypification of *S. indica*

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Abstract. Certain material of *Stachytarpheta* Vahl (Verbenaceae), mostly from the Caribbean coast of Central America (from Honduras to Panama), apparently related to *S. calderonii* Moldenke and *S. indica* (L.) Vahl, but consistently misidentified as *S. jamaicensis* (L.) Vahl, has been identified as *S. friedrichsthalii* Hayek. Examination of both syntypes of the latter name (*Fendler 219*, MO; *Friedrichsthal 466*, W) confirms that the calyx is more or less bilobed, versus 4-toothed in *S. jamaicensis*, under which *S. friedrichsthalii* has erroneously been placed in synonymy. One of the two sheets of *Friedrichsthal 466* (W)—the one corresponding to Field Museum negative 34320—is chosen as the lectotype. Contrary to recent suggestion, the latest lectotypification of *Verbena indica* L. (on a portion of LINN 35.1) is found to be consistent with its protologue, and the consequent synonymy of *S. angustifolia* (Mill.) Vahl under *S. indica* is here accepted. Furthermore, it is suggested that *S. friedrichsthalii* may also be the correct name for some African material that has been included in *S. indica* (in much the same way *S. friedrichsthalii* has been found among Central American material of *S. jamaicensis*).

Key words: Africa, Central America, Costa Rica, *Stachytarpheta*.

During the process of editing and revising the treatment of Verbenaceae (in the traditional sense) for the *Manual de Plantas de Costa Rica*, specimens were discovered among the *Stachytarpheta jamaicensis* (L.) Vahl material that, by virtue of an apparently herbaceous habit, relatively narrow leaves with crenate margins, and (especially) apparently bilobed calyces, should be compared more logically with *S. indica* (L.) Vahl than *S. jamaicensis* (a shrubby to suffruticose plant with wider, serrate-margined leaves and 4-toothed calyces). It should be noted that the terminology used here to describe the calyx follows Pool (2001) and varies slightly from that used by Atkins (2005), who described the calyx of *S. indica* (as *S. angustifolia* (Mill.) Vahl) as abaxially 2-toothed with an adaxial sinus, and that of *S. jamaicensis* as abaxially 4-toothed with an adaxial sinus. Atkins did not accept the lectotypification of *Verbena indica* L. (the basionym of *S. indica*) proposed by Moldenke and Moldenke (1983: 266) on the grounds that it "does not match Linnaeus' own description" (Atkins, 2005: 193). However, the description of *V. indica* used by Atkins to prove her point ("Simillima *V. jamaicensis*, sed Caulis laevis absque pilis. Folia glabra nec retrorsum scabra, magis lineata, non serrata, sed dentibus obtusis obliquis dentata; basi sensim angustata, nec petiolis late marginatis"; Linnaeus, 1762: 27), albeit discordant with the lectotype, is amended from that of the actual protologue (Linnaeus, 1759: 851) and thus inconsequential with regard to lectotypification. Conversely, the lectotype of *V. indica* (the larger branch on LINN 35.1) can in no way be construed as conflicting with the protologue ("Verbena diandra, spicis longissimus carnosis nudis, foliis lanceolato-ovatis oblique dentatis, caule laevi"), and therefore must be accepted. Moldenke and Moldenke (1983), Fernandes (1984), and Atkins (2005) all acknowledged that this lectotypification relegates *S. angustifolia* to synonymy under *S. indica*. We accept this consequence. Atkins (2005: 193), nevertheless, claimed that two distinct taxa are involved in the African material of *S. indica*: one coinciding with the New World species that has been called *S. angustifolia* and the other, with crenate and non-scabrous leaves (presumably the entity characterized as *V. indica* by Linnaeus in 1762), which she says "seems to occur only in Africa." We suggest that this second taxon may not be restricted to Africa at all, and that its correct name may be *S. friedrichsthalii* Hayek.

While no Costa Rican material agreeing with this concept of *Stachytarpheta indica* (i.e., *S. angustifolia* sensu Pool, 2001; Atkins, 2005) has come to light, numerous Costa Rican collections of *S. calderonii* Moldenke are known, all from the seasonally dry to moist lowlands of the north to central Pacific slope. This latter species is very similar to *S. indica*, but we have made no detailed study of the separation of these two; the taxonomy presented here in this regard (see key below) follows that in current use in Central

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America (e.g., Pool, 2001). Material first distinguished early in 2010 among specimens of *S. jamaicensis* from the continuously wet Caribbean lowlands was tentatively determined as *S. angustifolia*. However, this Caribbean material differs from both *S. angustifolia* (i.e., *S. indica*) and *S. calderonii*, which have at least marginally scabrous leaves with serrate margins, by its nonscabrous leaves with crenate margins.

During the process of evaluating this anomalous material at MO, a photograph—including the Field Museum scale with negative number 34320—of one of the syntypes (*Friedrichsthal 466*) of *Stachytarpheta friedrichsthalii* surfaced. That name was originally validated by Hayek (1907) on the basis of two collections: *Fendler 219* (W), from Río Chagres, Panama, and *Friedrichsthal 466* (W), from San Juan de Nicaragua. The type photograph fit clearly with the accumulating pile of material separated from *S. jamaicensis*. Meanwhile, a duplicate of *Fendler 219* was discovered at MO, and that too went with the separated pile. On close examination it was confirmed that all 36 specimens finally accumulated as distinct from *S. jamaicensis*, including the *Fendler 219* isosyntype, have a bilobed rather than 4-toothed calyx. Nevertheless, a major problem remained: *S. friedrichsthalii* was originally described as having the "Calyx...quadridentatus" (Hayek, 1907: 273), and probably for that reason has been placed or accepted in synonymy of *S. jamaicensis* by workers since (cf. Moldenke, 1973; Pool, 2001).

Some concern persisted that *Friedrichsthal 466* (W), the other syntype of *Stachytarpheta friedrichsthalii*, might actually have the 4-toothed calyx, typical of *S. jamaicensis*, given that the two species apparently occur in close sympatry (at least in Nicaragua, Costa Rica, and Panama) and the calyx detail cannot be seen in the photograph. This concern was soon alleviated, however, when two sheets of *Friedrichsthal 466* were found among specimens at MO on loan from W. Both sheets have the calyx bilobed and are clearly conspecific with the rest of the material separated from *S. jamaicensis*. The *Friedrichsthal 466* sheet bearing the Field Museum scale with negative number 34320 is here selected as the lectotype of *S. friedrichsthalii*. Although it shows no field notes, the aforementioned photo at MO (which first led us to the name *S. friedrichsthalii*) is obviously of this same Friedrichsthal sheet. This particular specimen is chosen not only because it is the best among the three examined, but also because the author of the species was working in Vienna at the time the name was published, as evidenced by the title of Hayek (1907). Furthermore, the sheet exhibits specific details of the protologue (e.g., "radici fusiformis crassa lignosa") not seen on the other sheets. Given that all known material of the syntypes has bilobed calyces, it is assumed that the "Calyx . . . quadridentatus" of the protologue is in error, probably copied from other texts or assumed from knowledge that most species in the genus have the calyx 4-toothed. Even if additional material of either of the syntypes surfaces and proves to be conspecific with *S. jamaicensis*, the present lectotypification coincides in a preponderance of characters with the protologue and has the advantage of expedience, in making use of an available name.

Although specimens of *Stachytarpheta friedrichsthalii* have been lost among those of *S. jamaicensis*, *S. friedrichsthalii* can be separated quite readily on the basis of its smaller leaves with crenate (vs. serrate) margins, entire (vs. irregularly dentate) inflorescence bracts, and bilobed (vs. 4-toothed) calyces. It appears to be more closely related to *S. indica* and *S. calderonii*, which have the same calyx morphology, as well as also being nonwoody herbs with rather thick and persistent inflorescence rachises in which the fruits are deeply sunk and tightly held. All three of these species appear to grow closely associated with lakes, rivers, seasonal pools, or the ocean. A key is provided to distinguish the four species discussed here.

KEY TO CENTRAL AMERICAN SPECIES CONFUSED WITH OR CLOSELY RELATED TO *STACHYTARPHETA FRIEDRICHSTHALII*

1. Calyx 4-toothed; inflorescence bracts irregularly toothed; leaves serrate; plants usually shrubby ..... *S. jamaicensis*
1′. Calyx 2-lobed; inflorescence bracts entire; leaves serrate or crenate; plants usually suffruticose to herbaceous.
    2. Leaves crenate, glabrous on both surfaces (except sparsely hirsute adaxially along the proximal portion of the midrib), not scabrous, oblong or (rarely) spatulate, rounded to obtuse or (rarely) acute at the apex..... ..... *S. friedrichsthalii*
    2′. Leaves serrate, sparsely hirsute on both surfaces, pustulose-puberulent adaxially and strigose-scabrous (at least along the margin), lanceolate to oblanceolate or (rarely) spatulate, obtuse to acuminate at the apex.
        3. Leaves (including the petiolar region) $\leq 4\times$ longer than wide, oblanceolate or (rarely) spatulate, obtuse to acuminate at the apex, coarsely serrate .... *S. calderonii*
        3′. Leaves (including the petiolar region) 6 to 10(or more) × longer than wide, narrowly lanceolate, acute to acuminate at the apex, shallowly serrate ..... *S. indica*

Stachytarpheta friedrichsthalii at present is known with certainty only from Central America, mainly along the Caribbean coast from Belize and Honduras

to Panama (see specimens on TROPICOS, determined by Hammel, Nov. 2010). It is often found sympatrically with *S. jamaicensis*, a species known from virtually throughout the New World tropics and introduced in Hawaii and the Old World tropics. Just one collection of *S. friedrichsthalii* (*Burch et al. 1207*, MO) has been found from the Pacific coast, on the Azuero Peninsula of Panama (Los Santos Province).

Although *Stachytarpheta* Vahl is considered an almost exclusively New World genus, a few species are nearly pantropical, and particularly troublesome is the fact that several names have been published based on Old World material, two of them older than *S. friedrichsthalii* (*S. bogoriensis* Zoll. & Moritzi and *S. fallax* (Baill.) A. E. Gonç.). Until now, the crenate-leaved entity in the *S. indica* complex (Atkins, 2005: 193) was the only one of these from Africa that had not been proposed as conspecific with any New World species. We believe this, too, may be conspecific with a New World species, namely *S. friedrichsthalii*. Among the material studied by us, only the African entity and *S. friedrichsthalii* have "Folia glabra nec retrorsum scabra, magis lineata, non serrata, sed dentibus obtusis obliquis dentata" (Linnaeus, 1762: 27), as well as a bilobed calyx. The mostly rounded to obtuse (vs. acute to acuminate) leaves with rounded (vs. acute) teeth make this material easy to distinguish from both *S. indica* and *S. jamaicensis*, the two species with which it has most often been mixed. Nevertheless, we could find only one specimen among mounted African material of *Stachytarpheta* at MO that might be a candidate for confirming the presence of *S. friedrichsthalii* on that continent (*Aké Assi 18822* from Guinea).

Because *Stachytarpheta friedrichthalii* has been confused in the New World with one of the pantropical species (*S. jamaicensis*) and most likely is widespread itself, we have made a survey of Old World names (as well as a few likely candidates among New World names) in search of others that might apply to *S. friedrichsthalii*, studying protologues and type images when available. Among these we found only *S. jamaicensis* f. *albiflora* Standl., described from Honduras, to agree on all counts with *S. friedrichsthalii*, and therefore consider it synonymous. For those who believe that the African entity with crenate, nonscabrous leaves and bilobed calyces, known since the time of Linnaeus, is the same as the Central American species of the same description, *S. friedrichsthalii* must be the name to use.

The principal taxonomic conclusions of this paper may be summarized with the following nomenclature.

Stachytarpheta friedrichsthalii Hayek, Repert. Spec. Nov. Regni Veg. 3: 273. 1907. TYPE: Nicaragua. [Río San Juan:] "San Juan de Nicaragua" [San Juan del Norte], 1841, [*A.*] *Fendler 466* (lectotype, designated here, W [FM neg. # 34320]; isolectotype, W).

Stachytarpheta jamaicensis (L.) Vahl f. *albiflora* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 4: 320. 1929, syn. nov. TYPE: Honduras. Atlántida: in sandy thicket along beach, Tela, 28 Dec. 1927, *P. C. Standley 53814* (holotype, F-583934).

Stachytarpheta indica (L.) Vahl, Enum. Pl. 1: 206. 1804. Basionym: *Verbena indica* L., Syst. Nat. (ed. 10) 2: 851. 1759. TYPE: Herb. Linn. No. 35.1 (lectotype, LINN, larger branch on right-hand side of sheet, designated by Moldenke & Moldenke [1983: 266]).

Stachytarpheta angustifolia (Mill.) Vahl, Enum. Pl. 1: 205. 1804. Basionym: *Verbena angustifolia* Mill., Gard. Dict. (ed. 8): no. 15. 1768. TYPE: Mexico. Veracruz: "La Vera Cruz," [*W.*] *Houstoun s.n.* (holotype, BM).

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Changes to Publication Requirements Made at the XVIII International Botanical Congress in Melbourne—What Does e-Publication Mean for You?

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ABSTRACT. Changes to the *International Code of Botanical Nomenclature* are decided on every 6 years at Nomenclature Sections associated with International Botanical Congresses (IBC). The XVIII IBC was held in Melbourne, Australia; the Nomenclature Section met on 18–22 July 2011 and its decisions were accepted by the Congress at its plenary session on 30 July. Several important changes were made to the *Code* as a result of this meeting that will affect publication of new names. Two of these changes will come into effect on 1 January 2012, some months before the *Melbourne Code* is published. Electronic material published online in Portable Document Format (PDF) with an International Standard Serial Number (ISSN) or an International Standard Book Number (ISBN) will constitute effective publication, and the requirement for a Latin description or diagnosis for names of new taxa will be changed to a requirement for a description or diagnosis in either Latin or English. In addition, effective from 1 January 2013, new names of organisms treated as fungi must, in order to be validly published, include in the protologue (everything associated with a name at its valid publication) the citation of an identifier issued by a recognized repository (such as MycoBank). Draft text of the new articles dealing with electronic publication is provided and best practice is outlined.

At the XVIII International Botanical Congress in Melbourne, Australia, in July 2011, two important changes were made to the *International Code of Botanical Nomenclature* (now the *International Code of Nomenclature for algae, fungi, and plants*) that will take effect from 1 January 2012. These changes will affect everyone who publishes names governed by this *Code*. As the *Melbourne Code* will not be published until approximately mid-2012, we felt it would be helpful to outline these changes, particularly those concerning effective publication in electronic media (in Articles 29, 30, and 31). For a concise report on all the changes to the *Code* accepted in Melbourne, see McNeill et al. (in press).

A draft wording of the revised Articles, Notes, and Recommendations on effective publication is provided to aid editors and publishers in establishing best practice for implementing this aspect of the *Code*. We also outline here what these changes do *not* mean, to guide those wishing to publish new names and typifications by electronic means. We urge readers to consult the report of the Special Committee on Electronic Publication accompanying the changes proposed before the Congress (Chapman et al., 2010), wherein the reasoning for the changes now accepted into the *Code* is set out.

DRAFT WORDING OF REVISED ARTICLES 29, 30, AND 31 AND RECOMMENDATIONS 29A, 30A, AND 31A

Here we reproduce the wording of all of the relevant Articles, Notes, and Recommendations (omitting the Examples), with the changes highlighted in **bold**. The wording here is provisional, pending the meeting of the Editorial Committee in December 2011 to finalize the printed version of the *Melbourne Code*.

ARTICLE 29

29.1. Publication is effected, under this *Code*, by distribution of printed matter (through sale, exchange or gift) to the general public or at least to botanical institutions with libraries accessible to botanists generally. **Publication is also effected by electronic distribution of material in Portable**

To encourage dissemination of the changes made to the *International Code of Nomenclature for algae, fungi, and plants*, this article will be published in *Botanical Journal of the Linnean Society*, *BMC Evolutionary Biology*, *Cladistics*, *Mycotaxon*, *MycoKeys*, *New Phytologist*, *North American Fungi*, *Novon*, *Opuscula Philolichenum*, *PhytoKeys*, *Phytoneuron*, *Phytotaxa*, PLoS ONE, *Systematic Botany*, and *Taxon*.

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Document Format (PDF; see also Art. 29.3 and Rec. 29A.1) in an online publication with an International Standard Serial Number (ISSN) or an International Standard Book Number (ISBN). Publication is not effected by communication of new names at a public meeting, by the placing of names in collections or gardens open to the public, by the issue of microfilm made from manuscripts, typescripts or other unpublished material, or by distribution electronically **other than as described above.**

29.2. **For the purpose of this Article, "online" is defined as accessible electronically via the World Wide Web.**

29.3. **Should Portable Document Format (PDF) be succeeded, a successor international standard format communicated by the General Committee (see Div. III) is acceptable.**

29.4. **The content of a particular electronic publication must not be altered after it is first issued. Any such alterations are not themselves effectively published. Corrections or revisions must be issued separately to be effectively published.**

RECOMMENDATION 29A

[Existing Recommendation replaced by the following:]

29A.1. **Publication electronically in Portable Document Format (PDF) should comply with the PDF/A archival standard (ISO 19005).**

29A.2. **Authors should preferably publish in publications that are archived, satisfying the following criteria as far as is practical (see also Rec. 29A.1):**

(a) The material should be placed in multiple trusted online digital repositories, e.g., an ISO-certified repository;

(b) Digital repositories should be in more than one area of the world and preferably on different continents;

(c) Deposition of printed copies in libraries in more than one area of the world and preferably on different continents is also advisable.

ARTICLE 30

30.1. **Publication by distribution of electronic material does not constitute effective publication before 1 January 2012.**

30.2. **An electronic publication is not effectively published if there is evidence associated with or within the publication that it is merely a preliminary version that was, or is to be, replaced by a version that the publisher considers final, in which case only that final version is effectively published.**

30.3. Publication by indelible autograph before 1 January 1953 is effective. Indelible autograph produced at a later date is not effectively published.

30.4. For the purpose of this Article, indelible autograph is handwritten material reproduced by some mechanical or graphic process (such as lithography, offset, or metallic etching).

30.5. Publication on or after 1 January 1953 in trade catalogues or non-scientific newspapers, and on or after 1 January 1973 in seed-exchange lists, does not constitute effective publication.

30.6. The distribution on or after 1 January 1953 of printed matter accompanying exsiccatae does not constitute effective publication.

Note 1. If the printed matter is also distributed independently of the exsiccata, it is effectively published.

30.7. Publication on or after 1 January 1953 of an independent non-serial work stated to be a thesis submitted to a university or other institute of education for the purpose of obtaining a degree is not effectively published unless it includes an explicit statement (referring to the requirements of the *Code* for effective publication) or other internal evidence that it is regarded as an effective publication by its author or publisher.

Note 2. The presence of an International Standard Book Number (ISBN) or a statement of the name of the printer, publisher, or distributor in the original printed version is regarded as internal evidence that the work was intended to be effectively published.

RECOMMENDATION 30A

30A.1. **Preliminary and final versions of the same electronic publication should be clearly indicated as such when they are first issued.**

30A.2. It is strongly recommended that authors avoid publishing new names and descriptions or diagnoses of new taxa (nomenclatural novelties) in ephemeral printed matter of any kind, in particular printed matter that is multiplied in restricted and uncertain numbers, in which the permanence of the text may be limited, for which effective publication in terms of number of copies is not obvious, or that is unlikely to reach the general public. Authors should also avoid publishing new names and descriptions or diagnoses in popular periodicals, in abstracting journals, or on correction slips.

30A.3. To aid availability through time and place, authors publishing nomenclatural novelties should give preference to periodicals that regularly publish taxonomic articles. **Otherwise, a copy of a publication (whether published as printed or electronic matter) should be sent to an indexing centre appropriate to the taxonomic group, and publications that exist only as printed matter** should be deposited in at least ten, but preferably more, botanical or other generally accessible libraries throughout the world.

30A.4. Authors and editors are encouraged to mention nomenclatural novelties in the summary or abstract, or list them in an index in the publication.

ARTICLE 31

31.1. The date of effective publication is the date on which the printed **or electronic** matter became available as defined in Art. 29 and 30. In the absence of proof establishing some other date, the one appearing in the printed **or electronic** matter must be accepted as correct.

[Existing Note 1 replaced by the following:]

***31.2.* When a publication is issued in parallel electronic and printed versions, these must be treated as effectively published on the same date unless the dates of the versions are different according to Art. 31.1.**

31.3. When separates from periodicals or other works placed on sale are issued in advance, the date on the separate is accepted as the date of effective publication unless there is evidence that it is erroneous.

RECOMMENDATION 31A

31A.1. The date on which the publisher or publisher's agent delivers printed matter to one of the usual carriers for distribution to the public should be accepted as its date of effective publication.

BEST PRACTICE

Authors of new names, editors, and publishers will all be interested in ensuring that the publications including new names are in accordance with the *Melbourne Code*, so that the names therein are effectively published. We suggest that those publishing in journals or monograph series and books that have online editions communicate with the editors so that best practice can be established across the community as quickly as possible. Many publishers have been carefully addressing the issues involved with the e-publication of novelties for some time (see Knapp & Wright, 2010); guidelines in PLoS One <http://www.plosone.org/static/policies.action#taxon>) and considerable interest in making these new *Code* changes function effectively has been apparent.

Some practices that we feel will help with the initial stages of e-publication of novelties that are according to the *Melbourne Code* are:

- Having each article bear the date of publication prominently (as is done in many journals, for example, *New Phytologist* or *Nature*).
- If an online early version is issued that is not the same as the final version (and thus not the place of effective publication), stamp each article with this fact prominently (for example, *American Journal of Botany*).
- Prominent display of the ISSN or ISBN of the publication on each article will help indexers establish effective publication.
- Publication in journals (or monograph series) that participate in the CLOCKSS system (see Knapp & Wright, 2010, for a description) or another international archive and preservation system will ensure long-term archiving.
- Authors of new names by electronic means should alert the appropriate indexing center as recommended in Rec. 30A.3—this will help indexers who may otherwise not be aware of electronically published names.

WHAT THESE CHANGES DO *NOT* MEAN

Although the new Articles and Recommendations use the terms PDF and PDF/A, this does not mean that publications must be issued *only* in that format to be effectively published. For example, some online journals issue papers in Hypertext Markup Language (HTML) format together with a parallel PDF version. In such cases, the PDF version will be effectively published. The stipulation that the General Committee for Botanical Nomenclature will communicate the acceptability of a new international standard format, should PDF ever be succeeded, means authors of novelties and the community using the *Code* can remain informed as to advances in the field and that the *Code* will be protected from obsolescence.

Use of the following means of electronic publication will *not* result in effective publication of novelties under the *Melbourne Code*:

- Publication on websites or in ephemeral documents available over the Internet (there are strict criteria for granting of ISSNs <http://www.issn.org>).

- Publication in journals without a registered ISSN or e-ISSN.
- Publication in books without a registered ISBN or e-ISBN.

The Recommendation approved to advise the deposition of a hard copy of any e-publication in a library suggests to botanists an action, but it does not set out standard practice or a protocol for librarians to follow. Librarians are themselves in a complex transition zone between publication modalities (Johnson & Luther, 2007), and botanists may find librarians to be unwilling or unable to accommodate single hard copy papers as individual accessions should the volume be great.

Two Other Important Changes to the *Code* Relating to the Publication of Names

The second change to the *Code* approved in Melbourne to take effect from 1 January 2012 is that the description or diagnosis required for valid publication of the name of a new taxon of all organisms falling under the *Code* may be in either English or Latin. This is the current provision for names of plant fossils, but all new non-fossil taxa have required a Latin description or diagnosis (fungi and plants from 1 January 1935; algae [including cyanobacteria, if treated under the *Code*] from 1 January 1958). This has no bearing on the form of scientific names, which continue to be Latin or treated as Latin. Individual journal requirements for Latin and/or English will, of course, be determined by the editors of those journals.

A third change to the *Code* approved in Melbourne relating to publication of names, but one not taking effect until 1 January 2013 (not 1 January 2012 as reported by Miller et al., 2011), is that all new names of organisms treated as fungi must, as an additional requirement for valid publication, include in the protologue (everything associated with a name at its valid publication) the citation of an identifier issued by a recognized repository (such as MycoBank <http://www.mycobank.org>). This will be publicized separately.

The requirement for a unique identifier for new names of fungi on or after 1 January 2013 does *not* apply to plants or algae; there is no need for authors of new names in these groups to request Life Science Identifiers (LSIDs)—or other identifiers—from indexing centers.

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Thirteen New Species of Neotropical Viscaceae (*Dendrophthora* and *Phoradendron*)

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ABSTRACT. A total of 13 new species of Viscaceae are described and illustrated for the genera *Dendrophthora* Eichler and *Phoradendron* Nutt. *Dendrophthora erythrantha* Kuijt is established from La Paz, Bolivia; *P. palandensis* is described from Zamora-Chinchipe, Ecuador. Eight species are newly described from Peru: five from Cajamarca (*D. cryptantha* Kuijt, *D. microphylla* Kuijt, *D. subsessilis* Kuijt, *P. alatum* Kuijt, and *P. camposii* Kuijt); two from Amazonas (*D. verrucosa* Kuijt and *P. nickrentianum* Kuijt); and one from Chachapoyas (*P. prolongatum* Kuijt). Three species are described from Venezuela: one from Carabobo (*P. concinnum* Kuijt) and two from Miranda (*D. mirandensis* Kuijt and *P. mirandensis* Kuijt).

Key words: Bolivia, *Dendrophthora*, Ecuador, IUCN Red List, Neotropical Viscaceae, Peru, *Phoradendron*, Venezuela.

The earlier monographic studies on the Neotropical viscaceous genera *Dendrophthora* Eichler and *Phoradendron* Nutt. (Kuijt, 1961, 2000, 2003a) apparently have by no means exhausted the great diversity of these genera in Neotropical areas. As a continuation of those studies, scrutiny of various herbaria and, especially, new materials that have been sent to me from the Missouri Botanical Garden, has revealed 13 more species that so far have not been accounted for. It is the purpose of the present contribution to bring these species to the notice of botanical science. It may be expected that even more entities will emerge in the future. The present paper raises the number of known species in *Dendrophthora* to 116 and in *Phoradendron* to 241.

1. Dendrophthora cryptantha Kuijt, sp. nov. TYPE: Peru. Cajamarca: Sallique, Quebrada Grande, ruta entre La Cocha y Tablón, 2770–2900 m, 30 June 1998, *C. Díaz, J. Campo, T. Guevara & E. Tineo 9793* (holotype, UC; isotype, MO not seen). Figure 1.

Haec species inter congeneros quoad inflorescentiam subsessilem globularem *Dendrophthorae harlingii* Kuijt tantum similis, sed ab ea habitu robustiore, cataphyllis basalibus plerumque absentibus, lamina foliari angustiore atque praecipue systemate reproductivo monoico perfacile distinguitur.

Plants monoecious, robust, erect, somewhat succulent, glabrous except for some short, thick, convoluted yellow hairs at the base of young organs; stem internodes to 5 cm long, terete proximally, somewhat compressed below the nodes; basal cataphylls lacking, occasionally 1 pair 2–8 mm above the base; lowest foliar organs in median position. Prophylls prominent, acute, fringed with short, yellow hairs when young. Leaf blades to 5 × 1 cm, narrowly lanceolate to elliptic, apex obtuse to rounded, base acute, petiole 3–5 mm, indistinct; venation obscure. Inflorescence axillary, less than 5 mm long, peduncle 1 mm, bearing a single, globular internode with 6 flowers in biseriate or triseriate pattern, the flowers largely embedded in the swollen inflorescence axis; median flowers pistillate, lateral ones staminate. Fruits not known.

IUCN Red List category. *Dendrophthora cryptandra* is assessed as DD or Data Deficient, according to IUCN criteria (2001).

Discussion. *Dendrophthora cryptantha* is the second known species in *Dendrophthora* with nearly sessile, globular inflorescences, the other species being *D. harlingii* Kuijt (Kuijt, 2003b), originally described from Morona-Santiago but more recently also collected in Cajamarca. Nevertheless, they can scarcely be confused: *D. harlingii* is more slender and has basal cataphylls that *D. cryptantha* mostly lacks. The leaf blade of *D. harlingii* is broadly spatulate-obovate, while that of *D. cryptantha* is narrower. Most importantly, their breeding system differs in that *D. cryptantha* is monoecious while *D. harlingii* is dioecious.

2. Dendrophthora erythrantha Kuijt, sp. nov. TYPE: Bolivia. La Paz: Prov. Inquisivi, comunidad Choquetanga (serranías de Lulini) a 13.5 km de Choquetanga, 16°44′S, 67°20′W, 3310 m, 3 Mar. 1994, *N. Salinas 2607* (holotype, UC; isotype, LPB not seen). Figure 2.

Haec species *Dendrophthorae microphyllae* Kuijt persimilis, sed ab ea caulibus foliisque brevipubescentibus,

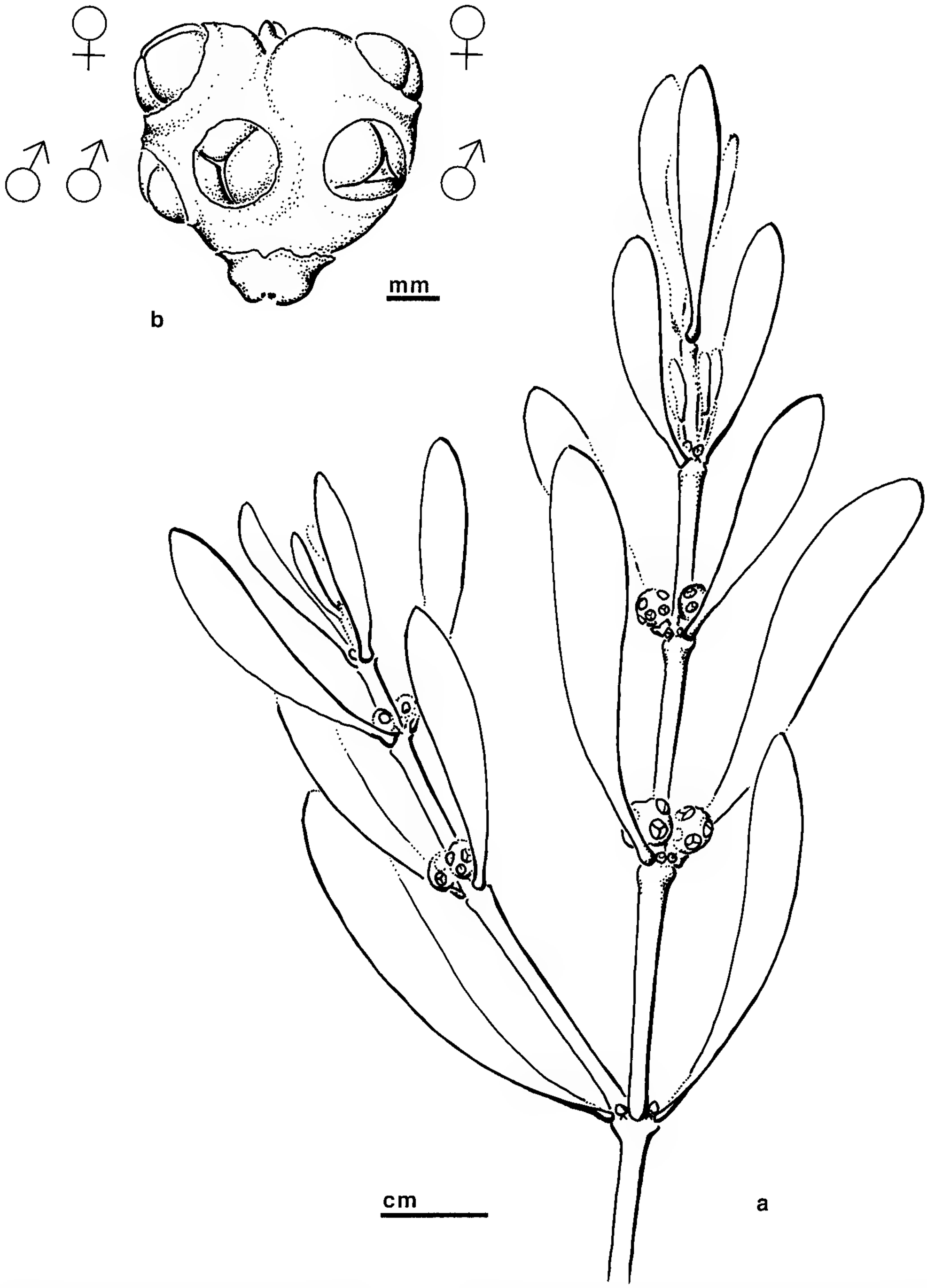

Figure 1. *Dendrophthora cryptantha* Kuijt. —A. Habit. —B. Inflorescence. Drawn from the holotype *Díaz et al. 9793* (UC).

cataphyllis basalibus subacicularibus ad omnes ramos laterales minores praesentibus sed ad majores ut videtur absentibus, internodiis fertilibus 1 vel 2 atque systemate reproductivo dioico distinguitur.

Plants dioecious, delicate, covered with minute, short epidermal hairs, stems succulent, with prominent ridges when dry; lateral shoots with 1 pair of nearly acicular basal cataphylls to 4 mm, in median

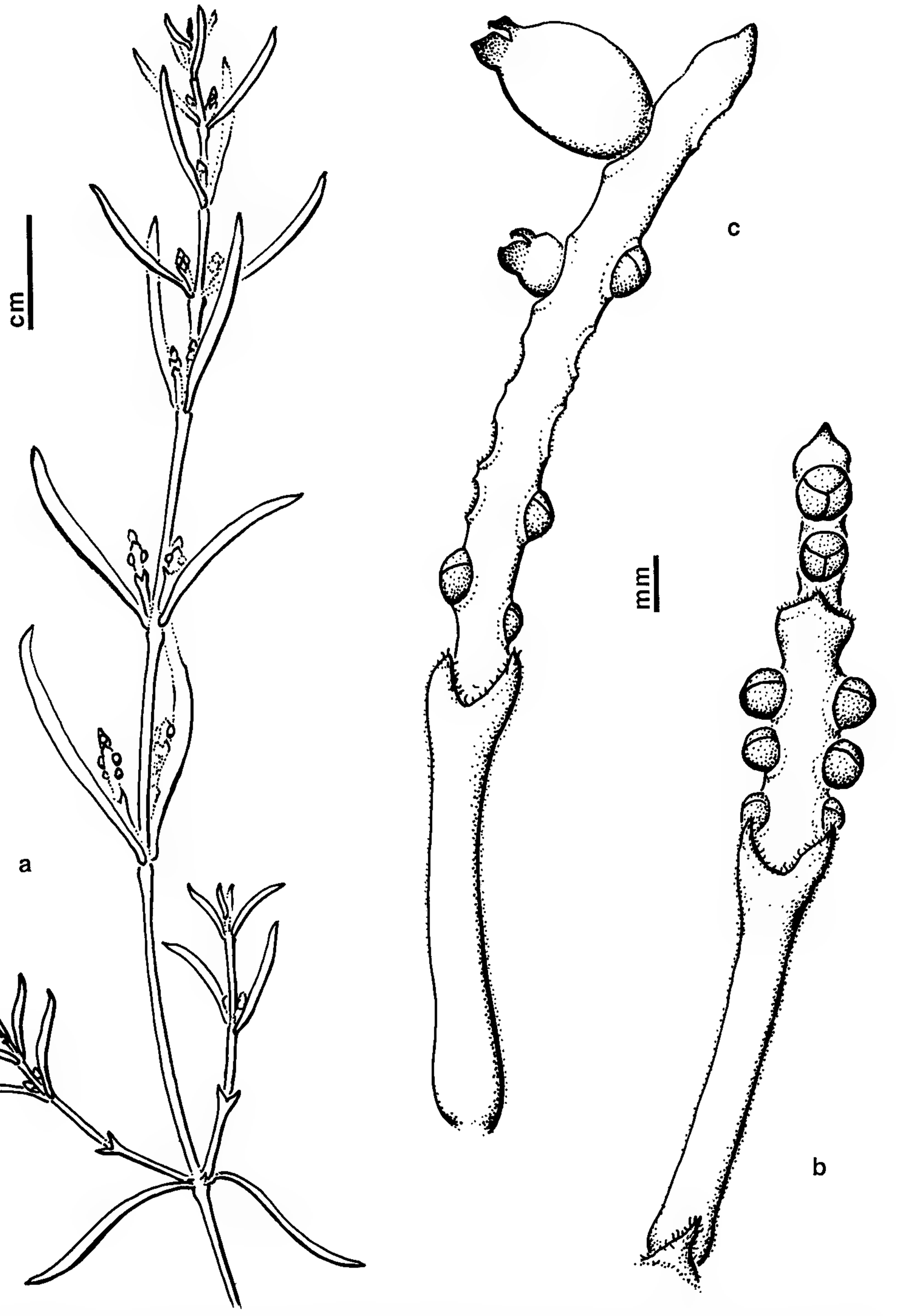

Figure 2. *Dendrophthora erythrantha* Kuijt. —A. Habit of staminate plant. —B. Staminate inflorescence. —C. Pistillate inflorescence, showing persistent petals on fruits. A, B drawn from the holotype *Salinas 2607* (UC); C from *Beck et al. 28851* (UC).

position, 1–1.5 cm above the base, basal cataphylls absent on many larger lateral shoots; prophylls prominent, acute, fimbriate. Leaves to 1.5 × 0.3 cm, succulent, lorate or nearly so, apex rounded to acute, base tapering into indistinct petiole ca. 1 mm; venation obscure. Inflorescences axillary, solitary, 1–2 cm, slender; peduncle 5–7 mm, with yellow, acute fertile bracts; fertile internode 1 for pistillate flowers,

1 or 2 in the staminate, flowers uniseriate, to 6 per fertile bract, deeply sunken in the axis, bright red to yellowish red, ca. 1 mm diam., the floral cups finely papillate marginally. Fruit 3 × 2 mm, ovoid, yellowish with dark, persistent, erect petals.

IUCN Red List category. *Dendrophthora erythrantha* is assessed as DD or Data Deficient, according to IUCN criteria (2001).

Discussion. *Dendrophthora erythrantha* is very similar to the *D. microphylla* described below, but scrutiny reveals significant differences. In contrast to that species, its stems and leaves are covered with short epidermal hairs, its basal cataphylls are extremely long and pointed, being borne on all smaller branches but apparently absent from larger ones, and its inflorescences consist of one or two fertile internodes (vs. two or three? in *D. microphylla*). *Dendrophthora erythrantha* is dioecious, while *D. microphylla* may be possibly monoecious. The known localities of the two species are about 2000 km apart, from Bolivia and Peru, respectively. *Dendrophthora erythrantha* is a member of a large group of *Dendrophthora* species characterized by uniseriate inflorescences, including *D. fastigiata* Kuijt, *D. microphylla*, *D. squamigera* (Kuntze) Benth., and others. The type for *D. erythrantha* is pistillate; the paratype specimen staminate.

Paratype. BOLIVIA. **La Paz:** Prov. Nor Yungas, Homuni Alto, 15 m al costado de la 3a estación metereológica, zona de neblina, 16°11′S, 66°54′W, 3140 m, sobre Ericaceae, 7 Aug. 2003, *Beck et al. 28851* (LPB, UC).

3. Dendrophthora microphylla Kuijt, sp. nov. TYPE: Peru. Cajamarca: Jaén, Sallique, localidad de Lanchal, 300 m, 27 June 1998, *C. Díaz, J. Campos, T. Guevara & E. Tineo 9700* (holotype, UC; isotype, MO-1104823 not seen). Figure 3.

Haec species *Dendrophthorae squamigerae* (Benth.) Kuntze ut videtur arcte affinis et *D. erythranthae* Kuijt persimilis, sed a hac caulibus foliisque glabris, cataphyllis basalibus ad ramos laterales plerumque absentibus, internodiis fertilibus 2 vel 3 atque systemate reproductivo monoico, ab illa habitu elongatiore atque foliis persistentibus distinguitur.

Plants presumed as monoecious, branching, erect, glabrous; stem internodes 1–2 cm, terete; basal cataphylls absent on most lateral branches, 1 pair 1–1.5 cm above the base on others. Leaves to 1 × 0.4 cm wide, persistent, fleshy, narrowly lanceolate, apex acute, base acute, petiole 2 mm, distinct. Inflorescence 2–3 cm, spreading to perpendicular to main stem, 1 per leaf axil, peduncle 5–7 mm, terete, fertile internodes 2 or 3, with 3 to 5 flowers in uniseriate rows, each flower clasped by a deep alveolus fringed with short, stiff, shiny marginal hairs. Fruit 2.5 × 2 mm, translucent white, petals persistent, erect.

IUCN Red List category. *Dendrophthora microphylla* is assessed as DD or Data Deficient, according to IUCN criteria (2001).

Discussion. *Dendrophthora microphylla* would seem to be closely related to the more northern *D. squamigera* and its relatives, but the plants are more elongated and have persistent leaves. *Dendrophthora squamigera* has small leaves only in its juvenile stage, but none subtend its inflorescences (cf. Kuijt, 1961: fig. 47b). See also comments under *D. erythrantha*.

4. Dendrophthora mirandensis Kuijt, sp. nov. TYPE: Venezuela. Miranda: Zamora, Cordillera de la Costa, Parque Nac. El Avila, El Bautismo, al NE de Guatire, zona de cafetales, 10°31′N, 66°29′W, 1250–1500 m, 4 Jan. 2006 (♀ fl.), *W. Meier & J. L. Hernández-Bretón 12539* (holotype, UC; isotype, VEN not seen). Figure 4.

Haec species quoad characteres nonnullos *Phoradendro kelloggii* Kuijt similis, sed ab eo surculis percurrentibus cataphyllis intercalaribus praeditis atque inflorescentiae quaque bractea fertili florem unicum subtendente distinguitur, inter congeneros quoad habitum saepe dichotomum atque inflorescentiam parvam paucifloram insignis.

Plants presumed dioecious, delicate, much branched; young parts very finely short-papillate; lateral branches delicate, with mostly 2 pairs of small basal cataphylls ca. 3 and 12 mm above the axil; lowest foliar organs of lateral median in position; branching occasionally percurrent, where provided with 2 pairs of intercalary cataphylls, but mostly dichotomous through the production of terminal inflorescences. Leaf blade to 4 × 1.5 cm, oblanceolate, avenous, apex obtuse and with small knoblike thickening, base cuneately tapering into indistinct petiole ca. 5 mm. Pistillate inflorescences nodal and terminal, peduncles simple or paired, the sterile internodes 1 mm, followed by 3 fertile internodes with 1 flower per fertile bract placed on the distal half of the internode. Neither the staminate plant nor the fruits are known.

Distribution and IUCN Red List category. The new species is known only from the type collection, and *Dendrophthora mirandensis* is assessed as DD or Data Deficient, according to IUCN criteria (2001).

Discussion. *Dendrophthora mirandensis* is an inconspicuous but morphologically highly distinctive

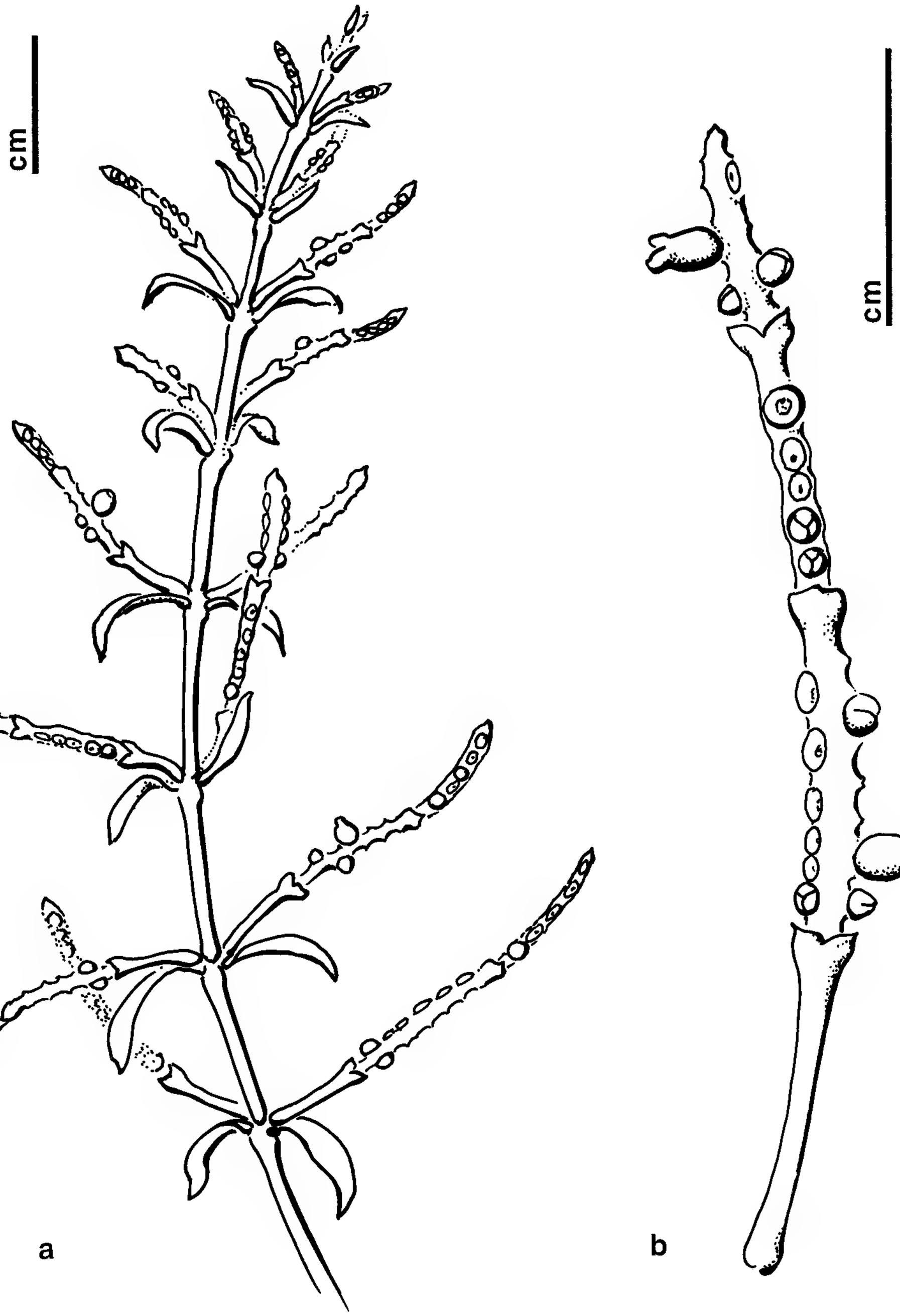

Figure 3. *Dendrophthora microphylla* Kuijt. —A. Fertile habit. —B. Infructescence. Drawn from the holotype *Díaz et al. 9700* (UC).

species, remarkable by its often dichotomous habit and the small, few-flowered inflorescences. The new taxon has a number of morphological features in common with the rare *Phoradendron kelloggii* Kuijt from Venezuela (Kuijt, 2003a), but, aside from the documented anthers, the latter has several flowers per fertile bract (vs. one and distally located) in a uniseriate pattern, and lacks intercalary cataphylls in its percurrent shoots. *Dendrophthora mirandensis* is known only from the pistillate plants of the type; staminate inflorescences may well be more floriferous, as in other dioecious *Dendrophthora* species.

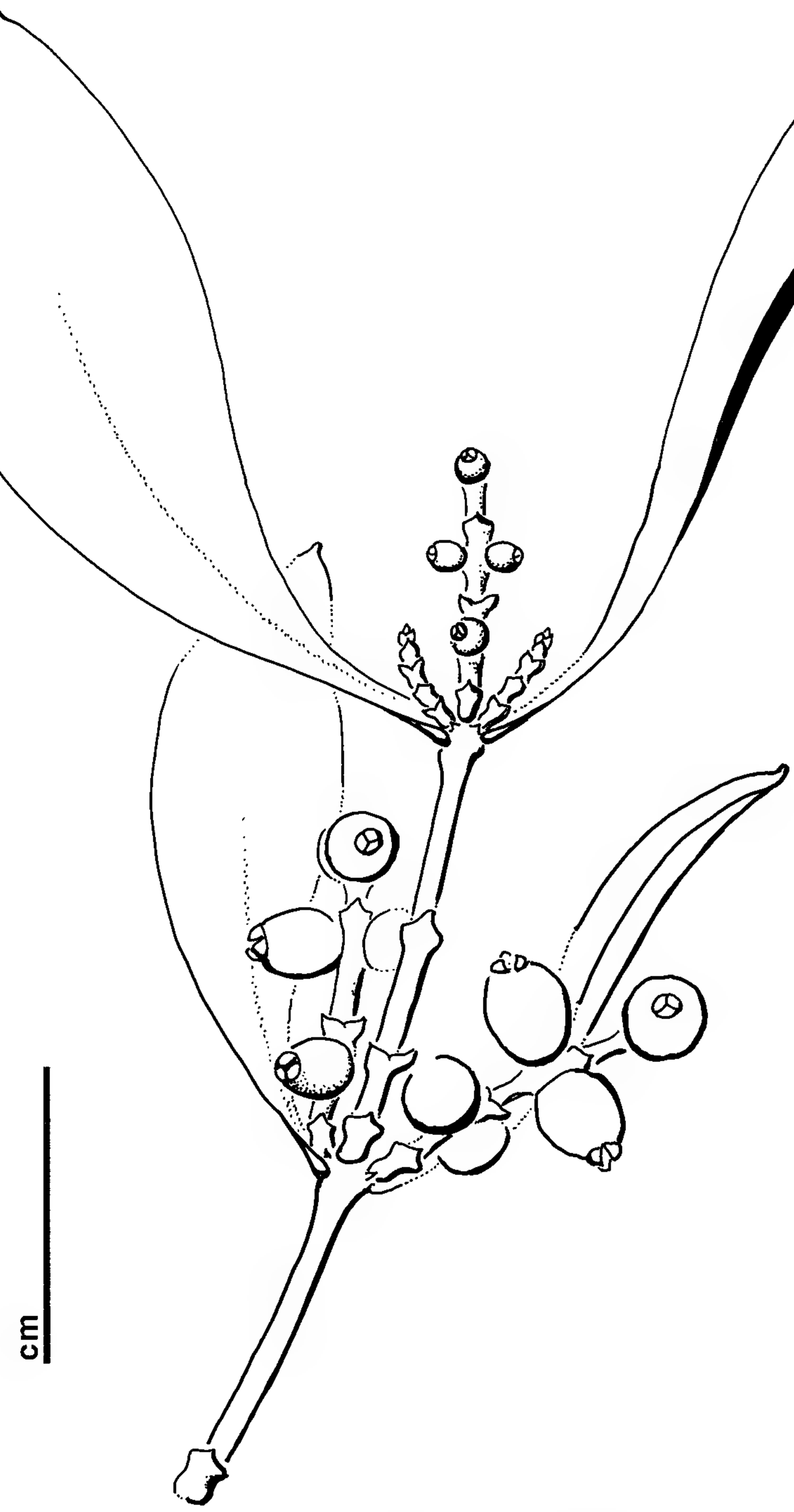

Figure 4. *Dendrophthora mirandensis* Kuijt. Innovation bearing fruit at lower node, with young inflorescences seen above. Drawn from the holotype *Meier & Hernández-Bretón 12539* (UC).

5. Dendrophthora subsessilis Kuijt, sp. nov. TYPE: Peru. Cajamarca: Prov. San Ignacio, Huarango–San Martín, Nuevo Peru, 5°22′S, 78°30′W, 900 m, 14 May 1996 (♂ fls.), *R. & A. Vásquez 20837* (holotype, UC; isotype, MO-4782656). Figure 5.

Haec species *Dendrophthorae costaricensi* Urb. verosimiliter affinis, sed ab ea foliis late obovato-spathulatis, inflorescentia staminata subsessili, floribus biseriatis atque systemate reproductivo dioico facile distinguitur, inter omnes congeneros quoad cataphylla basalia numerosa inter se remota insignis.

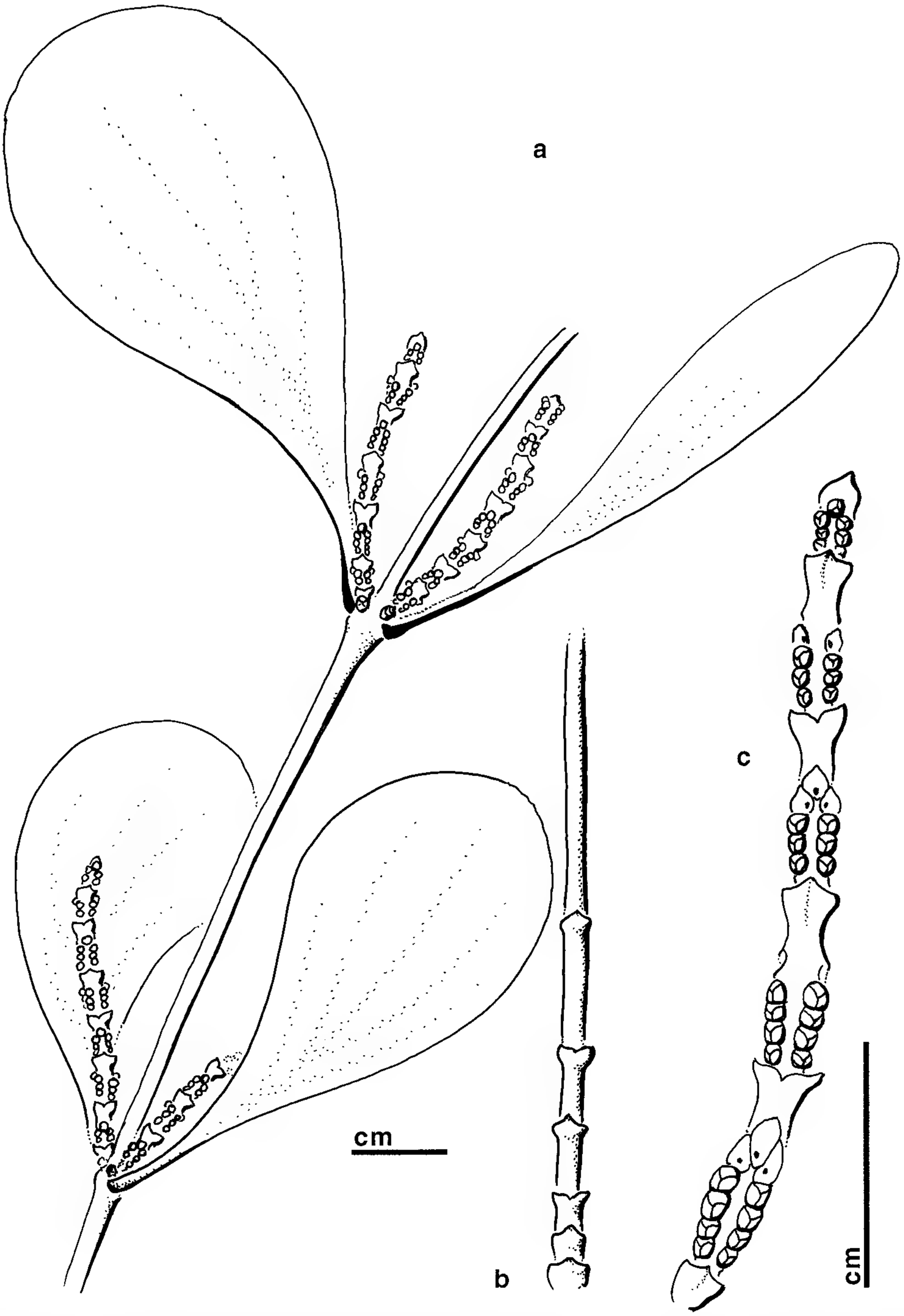

Figure 5. *Dendrophthora subsessilis* Kuijt. —A. Leafy shoot with inflorescences. —B. Basal cataphylls. —C. Inflorescence. A–C drawn from the holotype *R. & A. Vásquez 20837* (UC).

Plants dioecious, stature medium-sized, glabrous, percurrent; stem internodes to 7 cm long, terete; basal cataphylls in 4 to 6 pairs, the upper ones placed nearly halfway to the nearest foliar node. Leaf blades to 8 × 4 cm wide, broadly obovate-spatulate, apex rounded, base long-tapering to an indistinct, slender petiole ca. 1 cm; venation with 5 ± basal, fairly obscure veins, the middle one not reaching the apex.

Staminate inflorescence ca. 3 cm, peduncle extremely short, to 1.5 mm, followed by 5 to 7 fertile internodes, staminate flowers 5 to 13 per fertile bract, in biseriate rows. Pistillate plants not known.

Distribution and IUCN Red List category. *Dendrophthora subsessilis* is assessed as DD or Data Deficient, according to IUCN criteria (2001). The taxon is known only from the type collection.

Discussion. *Dendrophthora subsessilis* is probably related to the more northern *D. costaricensis* Urb. The new taxon is easily distinguishable because of its unusual leaf shape, the extremely short peduncle of the staminate inflorescence and the biseriate pattern of its flower, and the plant's dioecy. The large number of widely spaced basal cataphylls is also a very unusual feature in the genus.

6. Dendrophthora verrucosa Kuijt, sp. nov. TYPE: Peru. Amazonas: a few km. from Molinapampa, on scrub on sandy soil with rock outcrops, 14 Mar. 1998 (♂ fls.), *H. van der Werff, B. Gray, R. Vásquez & R. Rojas 14937* (holotype, UC; isotype, MO not seen). Figure 6.

Haec species *Dendrophthorae dimorphae* Kuijt subsimilis, sed ab ea internodiis verrucosis teretibus, ramis lateralibus cataphyllis basalibus praeditis atque foliis palmatim triveniis distinguitur.

Plants dioecious, densely leafy, erect, stems finely verrucose, with internodes to 5 cm, terete, brown; basal cataphylls as 1 pair, 5–10 mm above the base. Leaf blades ca. 4 × 2 cm, thin, elliptical to obovate, apex rounded, base tapering into indistinct, slender petiole ca. 8 mm; venation palmate, with 2 long basal lateral veins; leaf margin smooth, translucent when dry. Staminate inflorescence to 3 cm, axillary, usually in clusters of 3; peduncle simple, 5–7 mm, slender, with fertile internodes 2 or 3, flowers 19 to 30 per fertile internode and triseriate. Pistillate plant and fruits not known.

Distribution and IUCN Red List category. *Dendrophthora verrucosa* is assessed as DD or Data Deficient, according to IUCN criteria (2001), and is known only from the type collection.

Discussion. *Dendrophthora verrucosa* is an attractive species of erect stature, distinguishable by its brown, finely verrucose stems and elegant inflorescences with numerous triseriate flowers. I have verified the unilocular anther structure, which confirms the position of the species in *Dendrophthora*. The species may be confused with *D. dimorpha* Kuijt (Kuijt, 1990), but *D. verrucosa* differs in being distinctly verrucose rather than glabrous, in having terete rather than flattened and grooved internodes, and in having basal cataphylls on lateral branches. The leaves of the two species especially are very similar, but *D. dimorpha* has at least five palmate veins, while *D. verrucosa* has only three. The known localities of *D. dimorpha* and *D. verrucosa* are slightly more than 100 km apart, both known only from Amazonian Peru.

7. Phoradendron alatum Kuijt, sp. nov. TYPE: Peru. Cajamarca: Distr. San José de Lourdes, vic. of Poblado Los Llanos, 5°6′16″S, 78°51′11″W, 1875 m, 12 Oct. 2006 (♀ fl.), *J. Perea & V. Flores 2831* (holotype, UC; isotypes, AMAZ not seen, HUT not seen, MO not seen, MOL not seen, USM not seen). Figure 7.

Plantae perrobustae, glabrae, praecipue caulibus inflorescentiisque in sicco laccatae; internodia usque ad 5 cm longa et 12 mm crassa, valde quadrangularia usque 4-alata. Petiolus usque ad 2.5 cm longus; lamina foliaris usque ad 15 × 9 cm, subelliptica. Inflorescentiae ca. 5.5 cm longae, ad axillas foliares crebrae, internodiis sterilibus 2 vel 3 crebris, fertilibus ca. 6, quaque bractea fertili flores 4 ad 6 subtendente.

Plants presumed as monoecious, very robust, percurrent, glabrous, especially the stems and inflorescences lacquered when dry; stem internodes to 5 × 1.2 cm, strongly quadrangular to 4-winged. Leaf blades to 15 × 9 cm, ± elliptical; petiole to 2.5 cm, stout, distinct; venation pinnate, the strongly keeled midrib running into the apex. Inflorescences ca. 5.5 cm long, crowded in leaf axils, each with 2 or 3 short sterile internodes together 6–10 mm long, followed by ca. 6 fertile internodes each 8–10 mm long and swollen in the middle where bearing 4 to 6 sunken flowers, with those investigated being pistillate, per fertile bract. Fruit unknown, said to be yellowish orange.

Distribution and IUCN Red List category. The new species is known only from the type collection, and *Phoradendron alatum* is assessed as DD or Data Deficient, according to IUCN criteria (2001).

Discussion. *Phoradendron alatum* almost certainly belongs to the assemblage of species including *P. dipterum* Eichler, *P. fasciculatum* Kuijt, and several others, all of which are (perhaps exclusively) hyperparasitic on various other mistletoes, both Loranthaceae and Viscaceae. *Phoradendron dipterum* especially also has strongly quadrangular or even somewhat winged internodes. Unfortunately, the type of *P. alatum* is badly fragmented, and the illustration represents a reconstruction. The inflorescence ap-

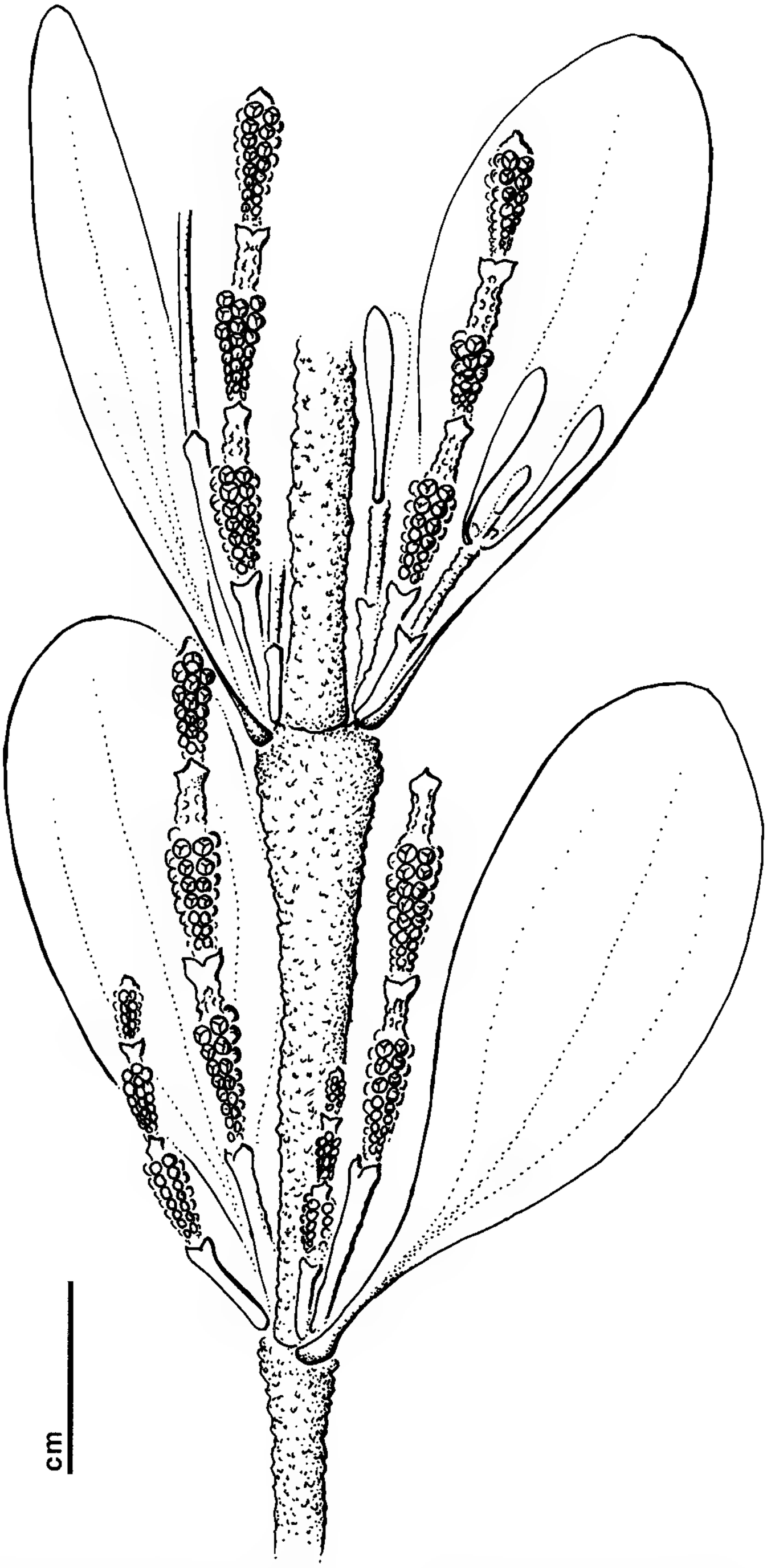

Figure 6. *Dendrophthora verrucosa* Kuijt. Fertile habit. Drawn from *van der Werff et al. 14937* (UC).

pears to have only pistillate flowers, but sex distribution in the related *P. dipterum* is extremely variable (Kuijt, 2003a), and dioecy in the present species is not clearly demonstrated.

8. Phoradendron camposii Kuijt, sp. nov. TYPE: Peru. Cajamarca: San Ignacio Prov., Distr. San José del Río Chirinos (Río mira flores), 5°12′S, 78°46′W, 600–700 m, 16 Apr. 1996, *J. Campos*

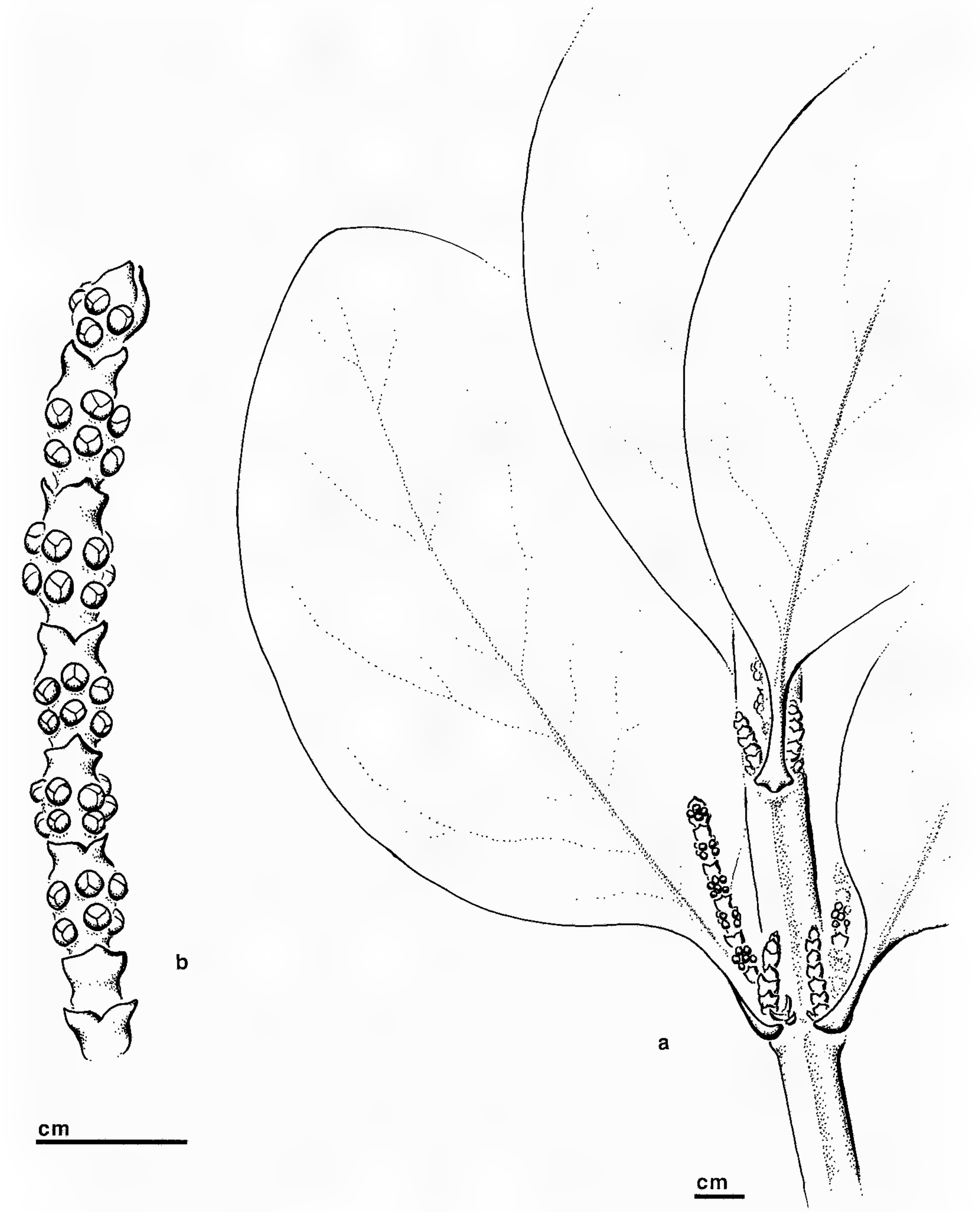

Figure 7. *Phoradendron alatum* Kuijt. —A. Fertile habit. —B. Inflorescence. A, B drawn from the holotype *Perea & Flores 2831* (UC).

& P. Díaz 2608 (holotype, UC; isotype, MO-1510501 not seen). Figure 8.

Haec species *Phoradendro quadrangulari* (Kunth) Griseb. persimilis, sed ab eo plantae partibus (praesertim caulibus foliisque) majoribus atque internodiis juvenibus veteribusque teretibus distinguitur.

Plants monoecious, medium-sized, glabrous; stem internodes to 4 cm, terete; basal cataphylls as 1 pair, 3 mm above the base, inconspicuous. Leaf blade to 7

Figure 8. *Phoradendron camposii* Kuijt. Fertile habit. Drawn from the holotype *Campos & Díaz 2608* (UC).

× 1.5 cm, spatulate, apex rounded, base acute to cuneate and tapering into a slender petiole ca. 3 mm; venation basal-palmate but obscure. Inflorescence to 3 cm long when in fruit, mostly 1 per leaf axil, peduncle simple, 2–3 mm, fertile internodes 3(4), flowers 3 to 7 per fertile bract, biseriate, mostly pistillate, staminate flowers few and irregularly placed. Fruit 3 × 2.5 mm, ovoid, yellow, petals close.

IUCN Red List category. *Phoradendron camposii* is assessed as DD or Data Deficient, according to IUCN criteria (2001).

Discussion. I have long hesitated before describing *Phoradendron camposii* as a separate species, as it is extremely similar to the common *P. quadrangulare* (Kunth) Griseb., which also occurs in northern Peru. However, the young and old stems are uniformly terete rather than quadrangular, and the plant (especially the stems and leaves) seems significantly larger than *P. quadrangulare*. The fact that two nearly identical collections are available from different but nearby localities now confirms its separate status.

Paratype. PERU. **Cajamarca:** San Ignacio Prov., Zapotal–Huarango, 5°21′S, 78°43′W, 600-1000 m, 20 Jan. 1996, *J. Campos & O. Díaz 2058* (UC).

9. Phoradendron concinnum Kuijt, sp. nov. TYPE: Venezuela. Carabobo: Limite Distr. Montalbán–Bejuma, Cordillera de la Costa, O de la carr. Bejuma–Canoabo, 10 km (dist. aera) NNO de Bejuma, Cerro El Marquero, bosque, 900–1000 m, 10°16′N, 68°17″O, 27 Dec. 2004 (♀ fl.), *W. Meier & N. Flanger 10887* (holotype, UC; isotype, VEN not seen). Figure 9.

Haec species sine dubio *Phoradendro craspedophyllo* Eichler et *P. harleyi* Kuijt arcte affinis, sed ab eis innovationibus sterilibus cataphyllis praeditis atque inflorescentiae internodiorum fertilium quaque bractea fertili flores usque ad 17 subtendente distinguitur.

Plants presumed dioecious, relatively small, only to 20 cm, glabrous, dichotomous by means of terminal inflorescences; sterile innovations to 9 cm, the internodes terete, basal cataphylls 2 pairs, at 2–3 mm and 13–17 mm above the base. Leaf blades to 6 × 2.5 cm, lanceolate, apex obtuse, base ± acute, tapering into 3 mm, indistinct petiole; venation palmate, with 3 major veins running to or near the apex. Inflorescence at least 2 cm at anthesis, peduncle simple, 2 mm, fertile internodes at least 5, flowers to 17 per fertile bract, triseriate. Infructescence elongating in fruit, fruits 3 × 2 mm, ovoid, placed in deep alveoli.

IUCN Red List category. *Phoradendron concinnum* is assessed as DD or Data Deficient, according to IUCN criteria (2001).

Discussion. *Phoradendron concinnum* is undoubtedly a close relative of *P. craspedophyllum* Eichler and *P. harleyi* Kuijt, differing from both in that the cataphylls on innovations are sterile, and in that the fertile internodes bear up to 17 flowers per fertile bract rather than only three. The aforementioned species are known only from the Brazilian states of São Paulo and Bahia, respectively. Both are monoecious, the median of each trio of flowers staminate, the two lateral ones pistillate. However, in *P. concinnum* I have not been able to establish its sex distribution, even though the type appears to be pistillate, bearing numerous fruits; no staminate flowers have been seen.

Paratype. VENEZUELA. **Distrito Capital–Miranda border:** Parque Nacional El Ávila, Cordillera de la Costa, al NE de Guatire, al NE de El Bautismo, camino a la sabana, bosque nublado, 10°32′N, 66°28′W, 1450 1550 m, 29 Feb. 2004, *W. Meier & Hernández-Brebón 10045* (UC, VEN not seen).

10. Phoradendron mirandensis Kuijt, sp. nov. TYPE: Venezuela. Miranda: Arboretum Escuela de Biología, SW del Valle de Caracas, Colinas de Bello Monte, 1100 m, 9 Apr. 1992 (♀ fl.), *N. Ramírez & M. López 3194* (holotype, UC; isotype, MO-1620946 not seen). Figure 10.

Haec species *Phoradendro congesto* Trel. subsimilis, sed ab eo internodiis teretibus, cataphyllis basalibus in pari unico, pedunculo brevissimo atque inflorescentiae quaque bractea fertili flores pauciores subtendente distinguitur.

Plants dioecious, leggy, glabrous, percurrent; stem internodes 4–9 cm long, terete; basal cataphylls as 1 pair; all scale leaves white-margined. Leaves 7–12 × 1.5–2.5 cm, narrowly elliptical, apex obtuse to rounded, base acutely tapering into indistinct petiole 5 mm long; venation palmate but mostly obscure. Pistillate inflorescences crowded at the (somewhat expanded) nodes, to 2 cm long, the peduncle simple, to 4 mm, fertile internodes mostly 3, flowers usually 3 per fertile bract, biseriate or triseriate, the proximal and distal fertile internodes often reduced to 1 flower per bract. Fruits 3.5 × 2.5 mm thick, ovoid, greenish yellow, the petals closed. Staminate plants not known.

Distribution and IUCN Red List category. All four specimens of the new species were gathered from the same locality. *Phoradendron mirandensis* is assessed as DD or Data Deficient, according to IUCN criteria (2001).

Discussion. *Phoradendron mirandensis* somewhat resembles *P. congestum* Trel. from Brazil and Amazonian Ecuador, differing in its very short inflorescence peduncle and fewer flowers per fertile bract. *Phoradendron mirandensis* also contrasts with its terete rather than quadrangular-keeled internodes and one pair rather than (mostly) two pairs of basal cataphylls.

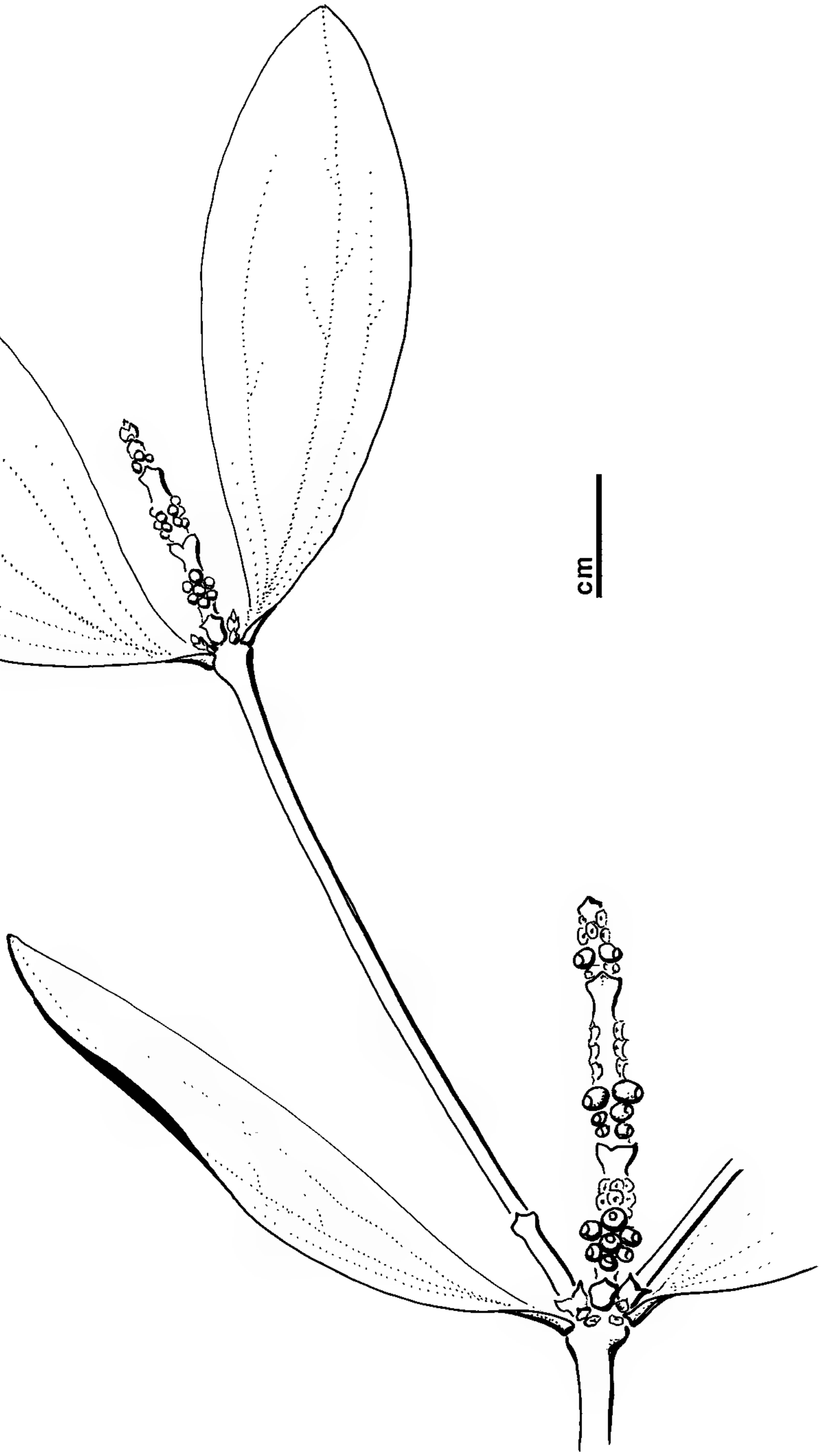

Figure 9. *Phoradendron concinnum* Kuijt. Habit, showing two terminal inflorescences and one innovation. Drawn from the holotype *Meier & Flanger 10887* (UC).

Paratypes. VENEZUELA. **Miranda:** Arboretum Escuela de Biología, SW del Valle de Caracas, Colinas de Bello Monte, on *Machaerium robiniifolium* Vogel, *M. López 291* (UC), *292* (UC); on *Zanthoxylum ciliatum* Engl., *López 293* (UC).

11. Phoradendron nickrentianum Kuijt, sp. nov. TYPE: Peru. Amazonas: Rodríguez de Mendoza, Mariscal Benavides, Izcuchaca, 6°19′40″S, 77°31′5″W, 1880 m, 29 Aug. 1998 (♂ fls.),

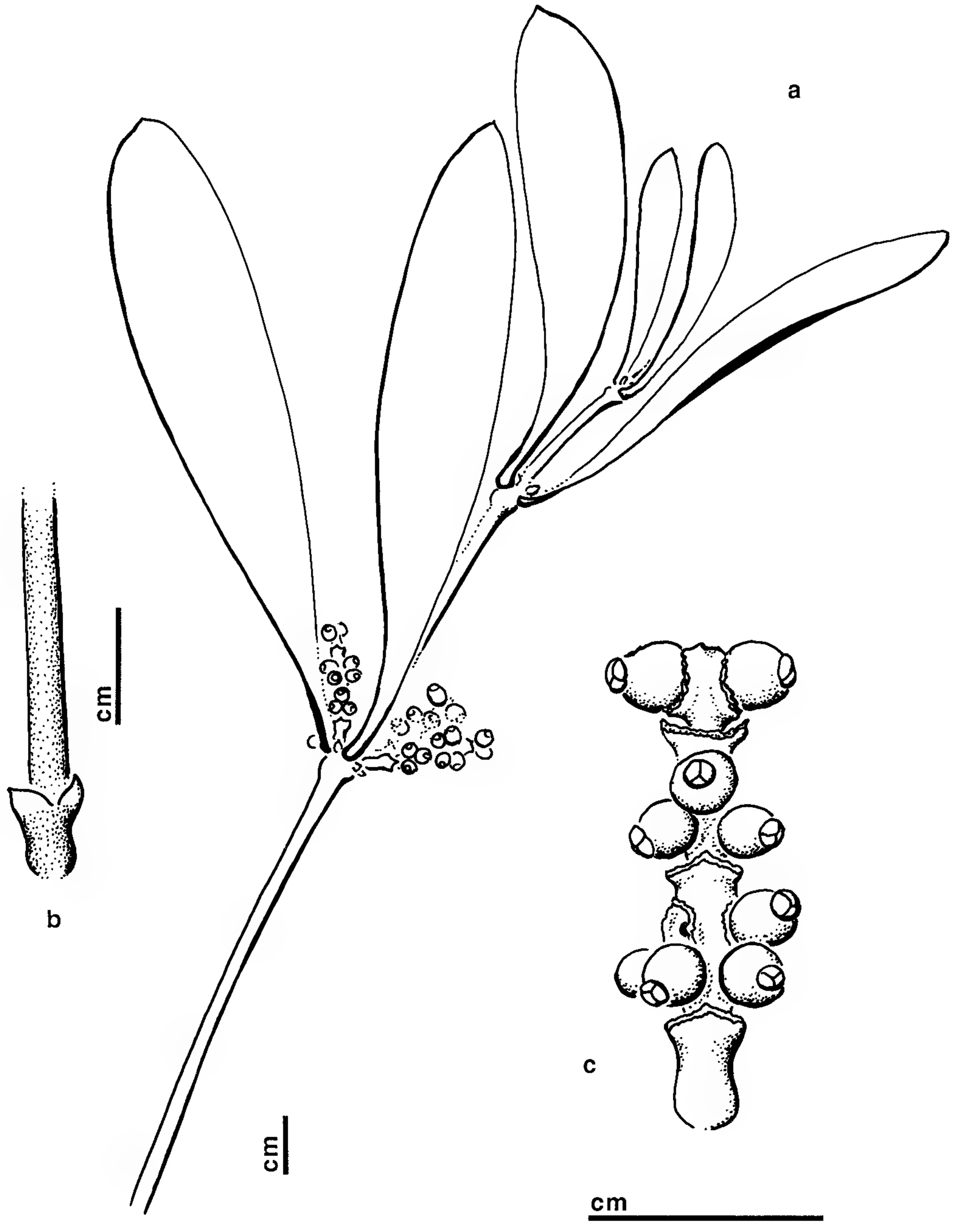

Figure 10. *Phoradendron mirandensis* Kuijt. —A. Habit. —B. Basal cataphylls. —C. Infructescence. A–C drawn from the holotype *Ramírez & López 3194* (UC).

R. Vásquez & J. Campos 25306 (holotype, UC; isotype, MO-1510519). Figure 11.

Haec species fere certe *Phoradendro undulato* (Pohl ex DC.) Eichler arcte affinis, sed ab eo cataphyllis basalibus in pari unico, pedunculo simplici atque inflorescentiae quaque bractea fertili flores 5 ad 9 subtendente distinguitur.

Plants dioecious, large, percurrent, glabrous; stem internodes to 9 cm, sharply keeled and expanded to nearly 1 cm below foliar nodes; basal cataphylls 1

Figure 11. *Phoradendron nickrentianum* Kuijt. —A. Fertile habit. —B. Inflorescence. A, B drawn from the holotype *Vásquez & Campos 25306* (UC).

pair, 1 cm above the base, inconspicuous, the following internode terete. Leaf blades to 14 × 4.5 cm, ovate to lanceolate, apex and base acute, petiole ca. 1 cm; venation pinnate, the midvein conspicuous and running into the apex. Staminate inflorescence to 4.5 cm, peduncle 2 mm, simple, followed by up to 9 fertile internodes; flowers 5 to 9 per fertile bract, biseriate. Pistillate plants unknown.

Etymology. *Phoradendron nickrentianum* is named in honor of Daniel L. Nickrent (1956–) of Southern Illinois University who, with numerous collaborators, has brought the knowledge of parasitic angiosperms to unprecedented heights.

Distribution and IUCN Red List category. *Phoradendron nickrentianum* is assessed as DD or Data Deficient, according to IUCN criteria (2001). It is known only from the type collection.

Discussion. The similarity of *Phoradendron nickrentianum* to *P. undulatum* (Pohl ex DC.) Eichler from Brazil is striking, and almost certainly indicates a close affinity. In contrast to the new species, however, *P. undulatum* usually has two or three pairs of basal cataphylls (vs. one pair), the upper pair(s) being placed very high on the branch, a compound inflorescence peduncle (vs. simple), and only five to seven flowers per fertile bract (vs. five to nine). Most importantly, *P. undulatum* is monoecious, while *P. nickrentianum* is dioecious. I have established that the species has bilocular anthers.

12. Phoradendron palandensis Kuijt, sp. nov. TYPE: Ecuador. Zamora-Chinchipe: Palanda, región de la Cordillera del Condor, Parroquia San Francisco de Vergel, riberas del Río Vergel, entre Santa Rosa y La Camela, 4°39′7″S, 79°1′41″W, 1200 m, 6 Mar. 2007 (♀ fls.), *W. Quizhpe & A. Wisum 2496* (holotype, UC; isotype, MO not seen, QCNE not seen). Figure 12.

Haec species *Phoradendro roldanii* Kuijt arcte affinis, sed ab ea ramificatione dichotoma, inflorescentia multo longiore atque internodiis fertilibus pluribus flores pauciores gerentibus distinguitur.

Plants dioecious, glabrous, dichotomously branching; innovations to 9 cm long, terminating in 1 pair of leaves, bearing 2 to 4 pairs of cataphylls, the uppermost pair often reaching the middle of the innovation; internodes terete but much expanded at the foliar nodes. Leaf blades to 9 × 6 cm wide, broadly lanceolate, apex nearly acute, base tapering into a flat, indistinct petiole ca. 5 mm; venation pinnate but obscure. Presumed pistillate? inflorescences to 11 cm long, clustered at the foliar nodes, with 2 or 3 short sterile internodes followed by up to 17 fertile internodes, each fertile bract subtending 3 to 5 flowers in a biseriate pattern. Staminate plants or flowers not known; fruit not seen, but said to be yellow.

Distribution and IUCN Red List category. *Phoradendron palandensis* is assessed as DD or Data Deficient, according to IUCN criteria (2001), and is known only from the type collection.

Discussion. Described from eastern Ecuador, *Phoradendron palandensis* is a close relative of the Colombian endemic *P. roldanii* Kuijt, differing in its dichotomous branching, much longer inflorescences with more numerous fertile internodes, the latter bearing fewer flowers. I have not been able to ascertain whether innovations in *P. palandensis* terminate in an inflorescence, or whether the dichotomous habit is a matter of abortion of the apex.

13. Phoradendron prolongatum Kuijt, sp. nov. TYPE: Peru. Chachapoyas: Marañon River Valley, Celendín–Chachapoyas rd., 25–35 km from Puente Chocanto, 2060–2500 m, 24 May 1984 (♂ fls.), *D. N. Smith & J. Cabanillas 7085* (holotype, UC; isotype, MO-1510515 not seen). Figure 13.

Haec species a congeneris internodiis elongatis usque ad 12 cm longis distaliter compressis carinatisque, foliis longis angustis atque floribus biseriatis distinguitur.

Plants dioecious, extremely leggy, glabrous, pendent, 1.5 m diam., percurrent; stem internodes to 12 cm, ± terete proximally, becoming keeled distally where compressed to 1 cm width below the nodes. Basal cataphylls 1 pair, about 5 mm above the base, spreading when dry, acute. Leaves to 11 × 3 cm, including the 1 cm, indistinct petiole, the blades coriaceous, narrowly lanceolate, apex obtuse, base long-tapering into petiole; venation pinnate, only the midrib evident. Staminate inflorescence solitary or in groups of 3 in leaf axils, nearly 3 cm long, peduncle simple, to 3 mm, followed by 3 fertile internodes bearing up to 13 flowers per fertile bract in a biseriate pattern.

Distribution and IUCN Red List category. *Phoradendron prolongatum* is assessed as DD or Data Deficient, according to IUCN criteria (2001).

Discussion. *Phoradendron prolongatum* is distinctive through its much elongated, flattened to keeled internodes to 12 cm and its long, narrow leaves, combined with the biseriate flower pattern. I have checked the anthers and, even though this plant occurs at higher elevations, which is atypical for *Phoradendron*, its bilocular anther clearly places it in that genus.

The above diagnosis does not include a curious feature seen in all available inflorescences for *Phoradendron prolongatum*, viz. terminal proliferation (see Fig. 13C). It is impossible to say at this time whether this terminal inflorescence portion will later

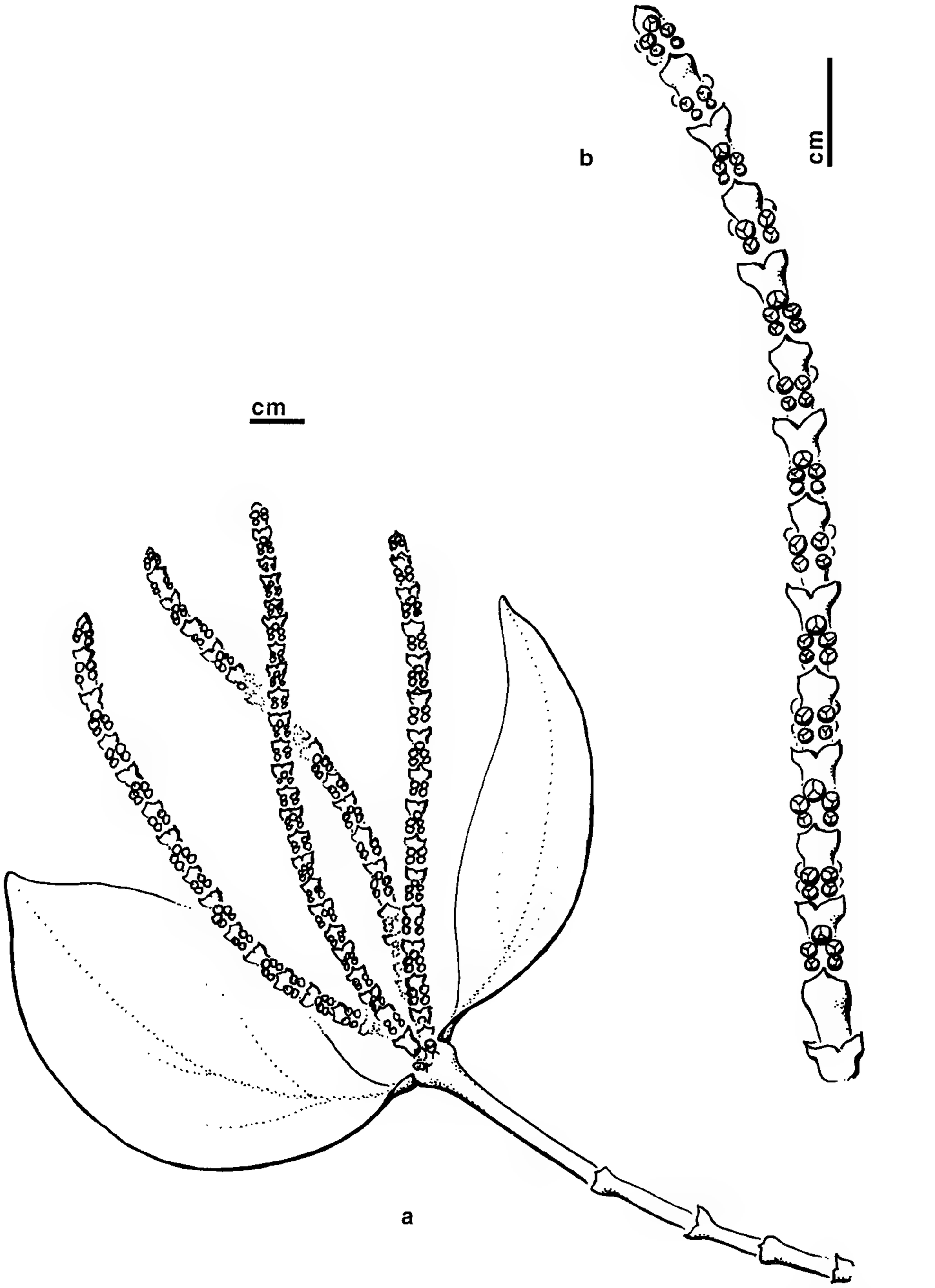

Figure 12. *Phoradendron palandensis* Kuijt. —A. Habit of determinate innovation. —B. Inflorescence. A, B drawn from the holotype *Quizhpe & Wisum 2496* (UC).

expand to produce a second crop of flowers. Similar maturation/development of the inflorescences is known to exist in the Cuban and Hispaniolan *Dendrophthora tetrastachya* (Wright ex Griseb.) Urb. (cf. Kuijt, 1961: 113, fig. 52), as well as in the Panamanian hyperparasite *P. fasciculatum* (Kuijt, 2003a). In both taxa, a second generation of flowers indeed does result, with the former separated from the

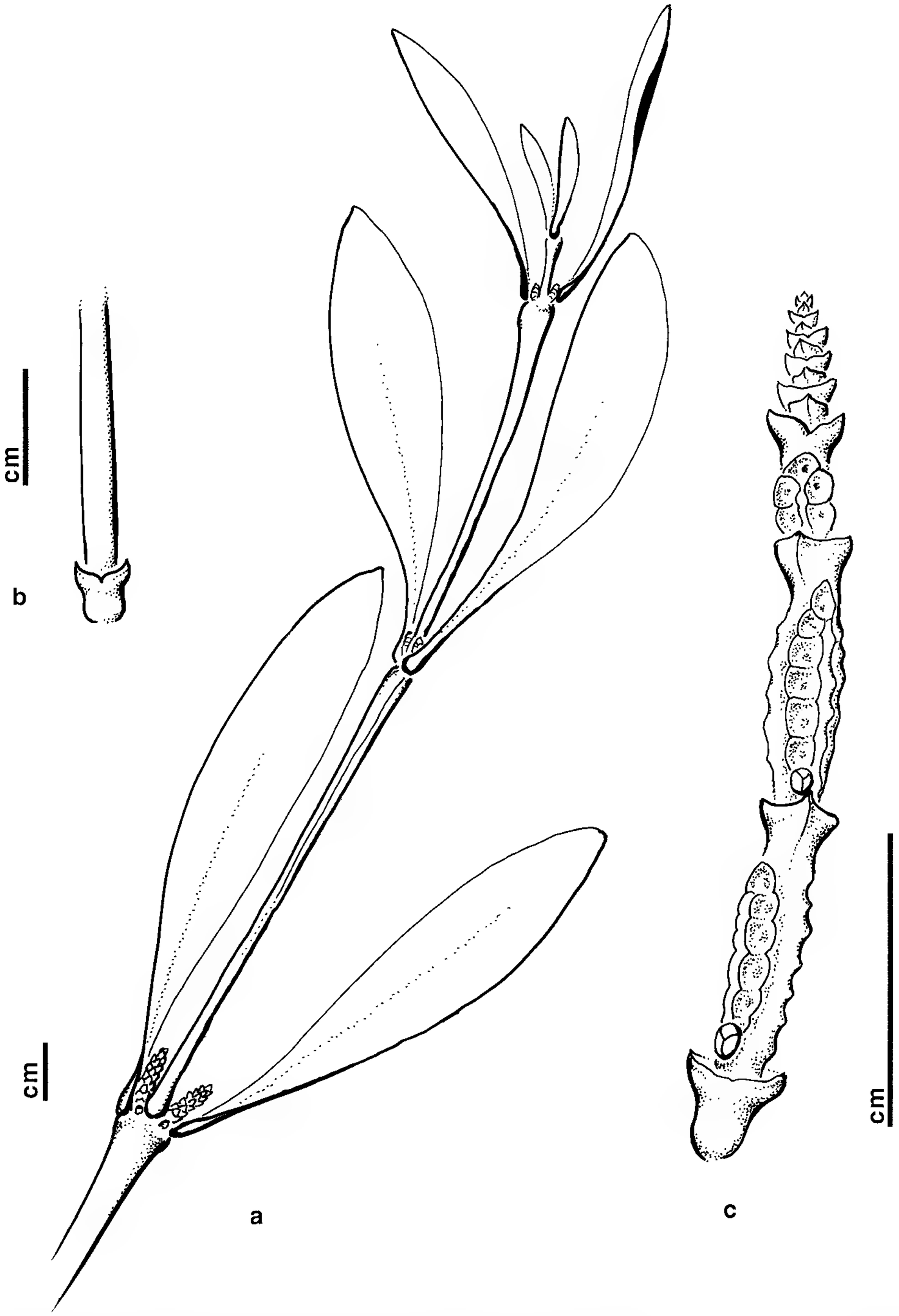

Figure 13. *Phoradendron prolongatum* Kuijt. —A. Leafy shoot. —B. Basal cataphylls. —C. Old inflorescence with proliferating tip. A–C drawn from the type *Smith & Cabanillas 7085* (UC).

earlier ones by a few cataphylls. The possibility of this proliferation in *P. prolongatum* being teratological cannot be excluded, but this might also be a specific character.

Acknowledgments. I am much obliged to Roy Gereau, Missouri Botanical Garden, for the Latin description and diagnoses. The continuing financial support of the Natural Sciences and Engineering

Research Council of Canada is gratefully acknowledged.

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Two New Species of *Oryctanthus* (Loranthaceae) from Colombia and French Guiana

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Abstract. Two new species of *Oryctanthus* (Griseb.) Eichler (Loranthaceae), *O. grammatus* Kuijt from Colombia (Bolívar) and *O. guianensis* Kuijt from French Guiana, are described and illustrated. Both are characterized by extremely short inflorescences and small leaves and unusual furfuraceous stem surfaces.

Key words: Colombia, French Guiana, IUCN Red List, Loranthaceae, *Oryctanthus*.

The genus *Oryctanthus* (Griseb.) Eichler (Loranthaceae) ranges from southern Mexico to Bolivia and Brazil (Kuijt 1976, 1992), having a single outlier in the Caribbean (Jamaica). It is sharply distinct from other small-flowered, Neotropical genera by the stellate fiber bundles in the leaves (Kuijt, 1961; Kuijt & Lye, 2005), the strap-shaped bracteoles flanking its flowers, and especially in the structure of the pollen grain, which is unique in the family (Feuer & Kuijt, 1985; Fig. 1). The genus was monographed in 1976 (Kuijt, 1976), with a more recent summary and description of an additional species *O. minor* Kuijt, also from French Guiana (Kuijt, 1992, 2009a).

A single specimen of each of two undescribed, small-leaved species was recently encountered during herbarium work at the United States National Herbarium and the Missouri Botanical Garden, and the present contribution describes and illustrates each. Both species are characterized by young stems with a strikingly striped cork pattern. This raises the number of known *Oryctanthus* species to 14.

1. Oryctanthus grammatus Kuijt, sp. nov. TYPE: Colombia. Bolívar: lands of Loba, San Martín de Loba & vic., "on mangle," Apr.–May 1916, *H. M. Curran s.n.* (holotype, US-537561). Figures 2, 3.

Haec species inter congeneros ob internodia juvenilia suberis lineis conspicue grammata atque flores inflorescentiasque minutas insignis, quoad inflorescentiam parvam *Oryctantho minore* Kuijt similis, sed ab eo inflorescentiae forma atque fructu ellipsoideo distinguitur.

Small, percurrent plants, internodes 8–40 mm, when young with 4 broad (often confluent), raised, erumpent lines of pustular, cinnamon-brown cork, these lines extending down from the petioles, the stems becoming ± glabrous with age. Leaf blade to 4 × 2 cm, narrowly obovate to elliptical, apex rounded, base acute, petiole 2–3 mm, distinct, leaf margins and most of the raised abaxial midvein furfuraceous, venation pinnate, the midvein not reaching the apex, stellate fiber bundles evident at least on dry leaves. Inflorescence 1 per leaf axil, no more than 3 mm (excluding fruits), sessile, flowers ca. 6, bisexual, inserted at an angle to the axis; mature buds 1.5 × 1 mm, apex obtuse; petals 6, nearly isomorphic, stamens biseriate, the shorter ones with a small connectival horn; anthers with 4 thecae; style 2/3 mm long, thick below, narrowing distally, the stigma undifferentiated. Fruits 3 × 1.5 mm, ellipsoid, apex truncate, calyculus inconspicuous, smooth.

Etymology. The epithet *grammatus* refers to the striped appearance of young internodes.

Distribution and habitat. *Oryctanthus grammatus* is known only from the type, collected nearly a century ago in an area that has been much cultivated. It is therefore conceivable that the species is extinct today.

IUCN Red List category. The new taxon is assessed as DD or Data Deficient, according to IUCN criteria (IUCN, 2001).

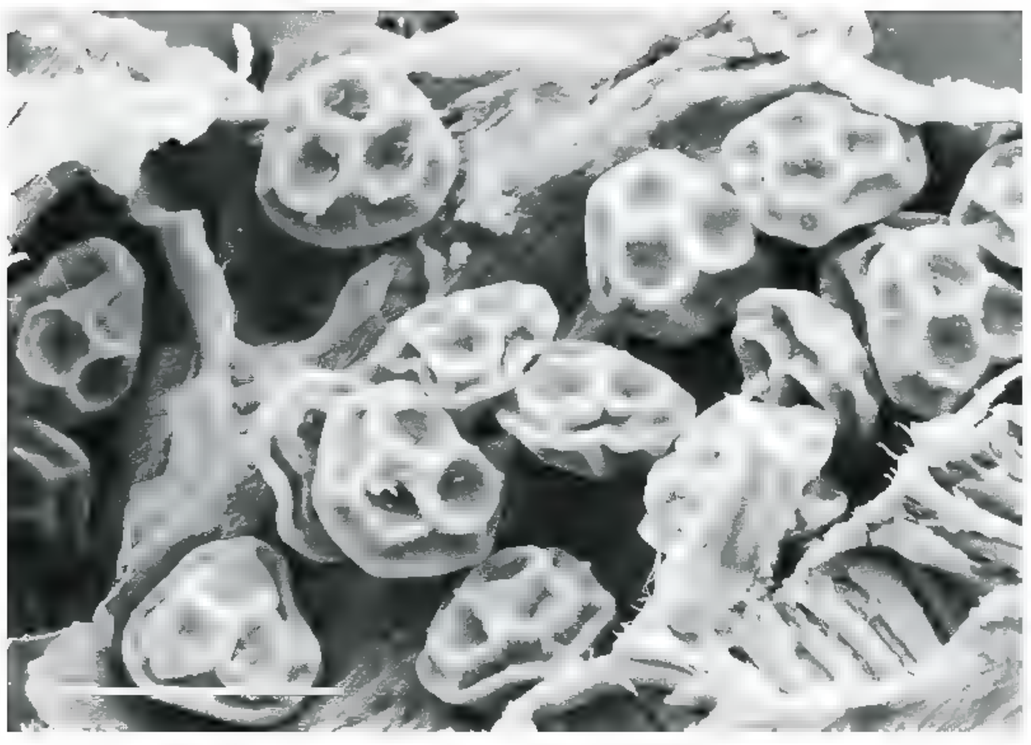

Figure 1. Pollen grains of *Oryctanthus guianensis* Kuijt. Taken from the holotype *Billiet & Jadin 5923* (MO). Scale bar = 50 μm.

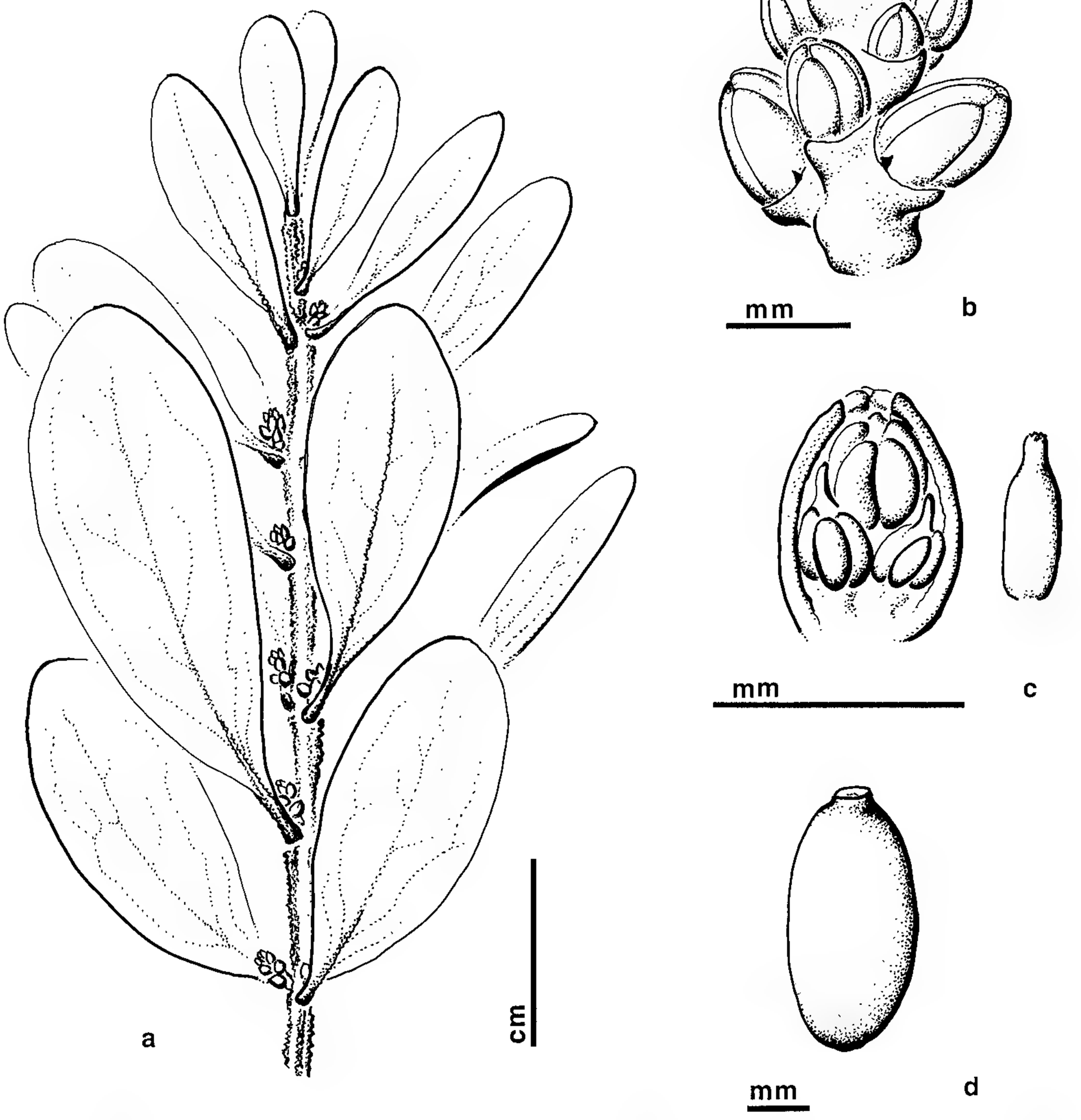

Figure 2. *Oryctanthus grammatus* Kuijt. —A. Flowering shoot. —B. Inflorescence. —C. Dissected bud, showing three petals and their stamens; style on the right. —D. Fruit. Drawn from the holotype *Curran s.n.* (US).

Discussion. *Oryctanthus grammatus* is an inconspicuous but exceedingly distinctive species by its minute inflorescences and flowers and the strikingly striped cork formation on young branches. The formation of similar cork, often in longitudinal lines, is common in many small-flowered, Neotropical genera, but none have the distinctive, striped features of *O. grammatus* (and the other species here described, *O. guianensis*). The recently described *O. minor* from French Guiana (Kuijt, 2009a) has a similarly small inflorescence, but a very different shape. Most strikingly, the stems of *O. minor* are completely covered with dense cork, and its fruits are depressed-globose.

The accompanying SEM photographs deserve some comments (Fig. 3). The cork stripes are sharply defined, the smooth (probably green when fresh) intervening lines showing numerous transverse or slightly oblique stomata. Enlargement of cork shows that very fine filaments extend outward from most cork cells. Similar filaments have been noted for two species of *Psittacanthus* (Kuijt, 2009b, fig. 1c), in

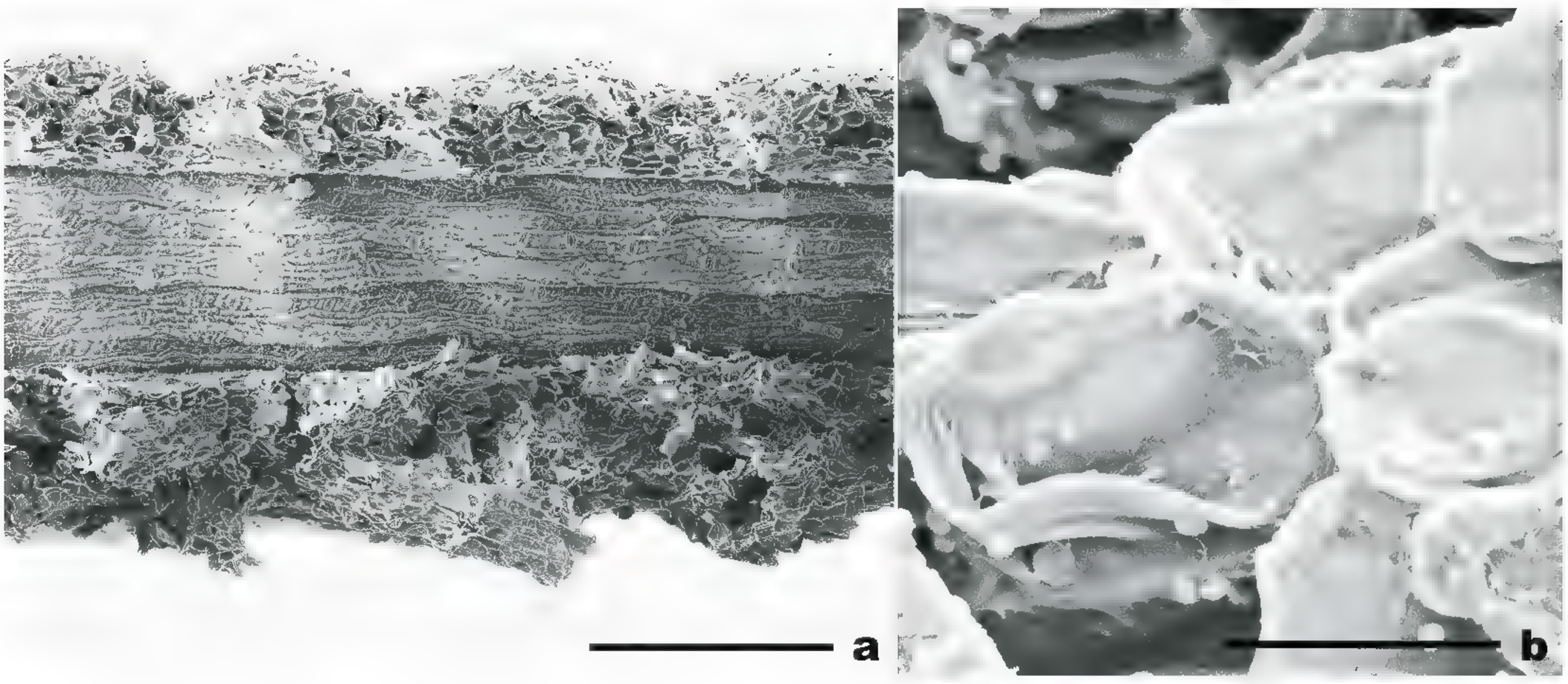

Figure 3. Cork development on *Oryctanthus grammatus* Kuijt. —A. SEM view of the cork stripes on a young stem. —B. Enlargement of collapsed cork cells, showing fine (probably waxy) filaments. The small spherical bodies scattered on the cell surfaces, each with minute prickles not here visible, are extraneous. Taken from the holotype *Curran s.n.* (US).

which the filaments arise from short epidermal hairs. The filaments are believed to represent waxy extrusions. It is not known how common such structures are in other mistletoes.

2. Oryctanthus guianensis Kuijt, sp. nov. TYPE: French Guiana. Kourou, garden, 5°10′N, 52°40′W, 5 m, on *Citrus*, 8 Mar. 1993, *F. Billiet & B. Jadin 5923* (holotype, MO; isotype, BR not seen, P not seen). Figures 1, 4.

Haec species quoad foliorum magnitudinem formamque *Oryctantho minore* Kuijt similis, sed ab eo internodiis juvenilibus subere in lineis (nec omnino) ornatis, antherarum connectivis cornu breviore praeditis atque fructu ovoideo-ellipsoideo laevi (nec tuberculato) distinguitur.

Sparsely branched plants, young stems with sharply defined, rough brown cork stripes extending down from the petioles, older stems smooth; internodes to 3.5 cm, strongly quadrangular, becoming nearly carinate distally. Leaf blade to 5 × 2.5 cm, coriaceous, elliptical, apex rounded, base obtuse, petiole 5 mm, distinct; phyllotaxy regularly decussate, leaf margin and abaxial midrib brown-furfuraceous; venation pinnate but obscure; stellate fiber bundles not visible. Inflorescence to 1.5 cm in fruit, but 7–8 mm in early anthesis, peduncle 1–4 mm, followed by 12 or more pairs of sessile flowers in deep axial depressions, subtended by a small leaf scale and flanked by 2 minute, flat bracteoles, the latter largely hidden in the floral cavity. Mature bud 2 mm long, acute or nearly so, nearly perpendicular to the inflorescence axis, bisexual, hexamerous, petals slightly dimorphic; anthers sessile, biseriate, 4-loculate, with small connectival horn; pollen as typical of the genus, with 3 circular depressions on each face (Fig. 1); ovary 0.5 mm. Fruit 6 × 3 mm, narrowly ovoid-ellipsoid, reddish orange at maturity, calyculus inconspicuous.

Habitat and distribution. *Oryctanthus guianensis* is known only from the type collection.

IUCN Red List category. The new taxon is assessed as DD or Data Deficient, according to IUCN criteria (IUCN, 2001).

Discussion. In terms of leaf size and shape, *Oryctanthus guianensis* appears to compare to the recently published *O. minor*, which is also from French Guiana (Kuijt, 2009a). However, that species has its young internodes completely covered with furfuraceous material, without any signs of striping, and its fruits are depressed-globose and slightly tuberculate, features at variance with *O. guianensis*. The connectival horns of the lower anthers of *O. minor* are also much longer than those of *O. guianensis*. Stellate fiber bundles are not evident on the rather thick, dried leaves of *O. guianensis* (or in *O. minor*), but may be assumed to be present, as they are characteristic of all other known species of *Oryctanthus*.

While the two new species described herein show some similarities, especially in the matter of the striking cork lines on young stems, a glance at the accompanying illustrations at once shows distinctive differences. The leaf blade of *Oryctanthus grammatus* is narrowly obovate to elliptical and has a clearly visible, pinnate venation, being thin. In *O. guianensis*

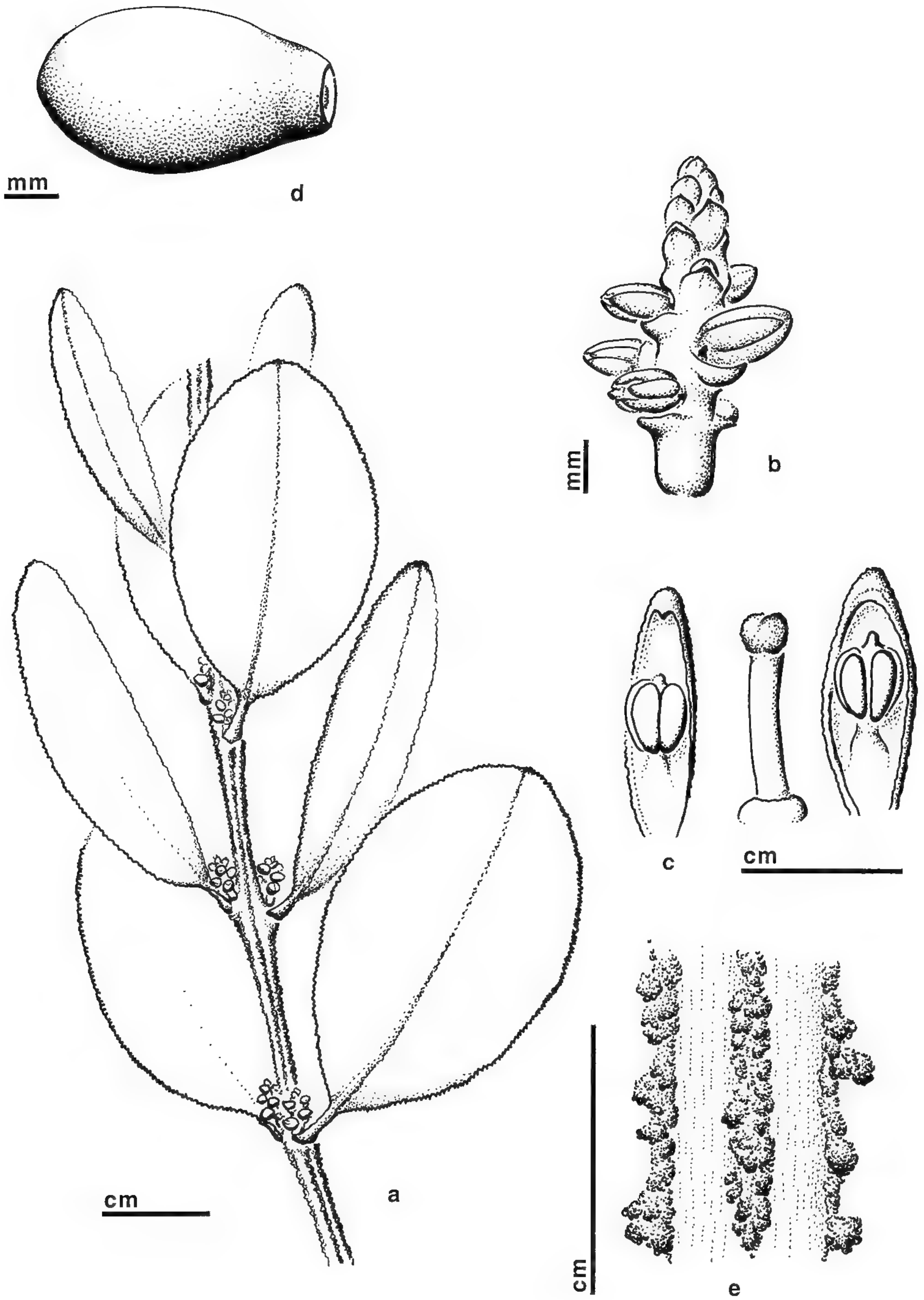

Figure 4. *Oryctanthus guianensis* Kuijt. —A. Habit. —B. Young inflorescence. —C. Floral dissection, showing two stamen-bearing petals and style (middle). —D. Fruit. —E. Enlargement of cork development on a young internode. Drawn from the holotype *Billiet & Jadin 5923* (MO).

the leaf blade is broadly elliptical, without evident venation except for the furfuraceous abaxial midrib that runs into the apex, the blade being coriaceous. The orientation of flowers on the inflorescence axis is angled in *O. grammatus*, perpendicular in *O. guianensis*, and the inflorescence of the latter becomes much longer (to 15 mm vs. 3 mm), and bears many more flowers than that of the former (24 or more vs. ca.

six). The style of *O. grammatus* is remarkably thick (Fig. 2C), an unusual feature in the genus.

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Notes on *Tetrorchidium* (Euphorbiaceae) in Panama

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Abstract. *Tetrorchidium brevifolium* Standl. & Steyerm. is reported for the first time from Panama and *T. trichotocarpum* McPherson is described, differing from those of its congeners also furnished with a 3-carpellate gynoecium and a glabrous cuplike pistillate disk, by its combination of subentire leaves, small petiolar glands, small stipules, near absence of pistillate bracteal glands, densely pubescent ovary, and occurrence in central Panama. A key to the six species of *Tetrorchidium* Poepp. (Euphorbiaceae) now known to occur in Panama is presented.

Key words: Euphorbiaceae, IUCN Red List, Panama, *Tetrorchidium*.

Recent fieldwork in a lowland rainforest in westernmost Colón Province, Panama, has brought to light several species previously unrecorded from Panama. One of these is reported here, and a second species also collected there, as well as previously at other sites within central Panama, is here recognized as new.

Some 20 (Radcliffe-Smith, 2001; Murillo, 2009) to 23 (Govaerts et al., 2000) species are currently attributed to *Tetrorchidium* Poepp. (Euphorbiaceae), most of them Neotropical and the remaining few native to Africa. In Panama, the genus is easily recognized by its dioecy, prominent petiolar or basilaminar glands, nearly sessile 2-armed hairs, and small, apetalous, 3-merous (although in some species bicarpellate) flowers borne in usually clustered, more or less raceme-like inflorescences.

Four Panamanian taxa were recognized by Webster and Huft (1988): *Tetrorchidium microphyllum* Huft, *T. costaricense* Huft, *T. euryphyllum* Standl., and *T. gorgonae* Croizat subsp. *robledoanum* (Cuatrec.) G. L. Webster. A fifth, *T. rotundatum* Standl., is listed in the *Catálogo de las Plantas Vasculares de Panamá* (Correa et al., 2004). A sixth species, *T. brevifolium* Standl. & Steyerm. (*C. L. Wilson 188*, holotype F), is now known to occur in Panama, as represented by *McPherson 19804*, *19805*, *20460*, *20531*, and *21284* (all at MO and PMA), all from the site mentioned above. This species can be distinguished from the five previously reported Panamanian taxa, and from other similar species of the Caribbean region and Central and South America, by its combination of a nearly complete lack of indument, relatively smooth stems, conspicuously resinous twig tips, few-flowered and slender pistillate inflorescences, relatively long pistillate pedicels, and 3-segmented pistillate disk. Previously known from Mexico, Guatemala, and Honduras (see Flora Mesoamericana, <http://www.tropicos.org/Project/FM> for records), this species is represented in Panama by populations that seem to differ from the more northwesterly ones only in having fewer pistillate flowers per inflorescence (one to two vs. two to six) and in growing at elevations below 300 m.

The taxon identified as *Tetrorchidium gorgonae* subsp. *robledoanum* by Webster and Huft (1988) is here recognized as a separate species. From *T. robledoanum* Cuatrec., the new species differs in having a 3-carpellate and densely pubescent ovary (vs. 2-carpellate and glabrous), clearly lobed stigmas (vs. shallowly lobed), and in being restricted to central Panama (vs. Colombia). From *T. gorgonae* s. str. and from *T. andinum* Müll. Arg., within which *T. gorgonae* has sometimes been synonymized (Webster, 1999; Murillo, 2009), the new species differs in its subentire leaves (vs. clearly dentate, at least distally), its densely pubescent ovary (vs. glabrous), and its distribution (central Panama vs. Colombia for *T. gorgonae*, vs. Colombia, Ecuador, and Peru for *T. andinum*).

Tetrorchidium trichotocarpum McPherson, sp. nov.
TYPE: Panama. Panamá: Cerro Jefe region, near rd. to Alto Pacora from near summit, 9°15′04″N, 79°30′04″W, 700 m, 31 Jan. 1987, *G. McPherson 10362* (holotype, PMA; isotype, MO). Figure 1.

A congeneris pariter ovario triloculato et disco pistillato glabro cupulato gaudentibus, species panamensis combinatione foliorum subintegrorum cum glandibus petiolaribus parvis, stipulis parvis, glandibus bractearum pistillatarum subnullis et ovario dense pubescenti distinguenda.

Tree 4–20 m tall, without evident exudate from cut twigs; stems appressed-pubescent with short-stalked 2-armed hairs, without resinous residue apically, the older leafless portions not roughened. Leaf blades elliptic to obovate, (5–)8–17 × (2–)3–8.5 cm,

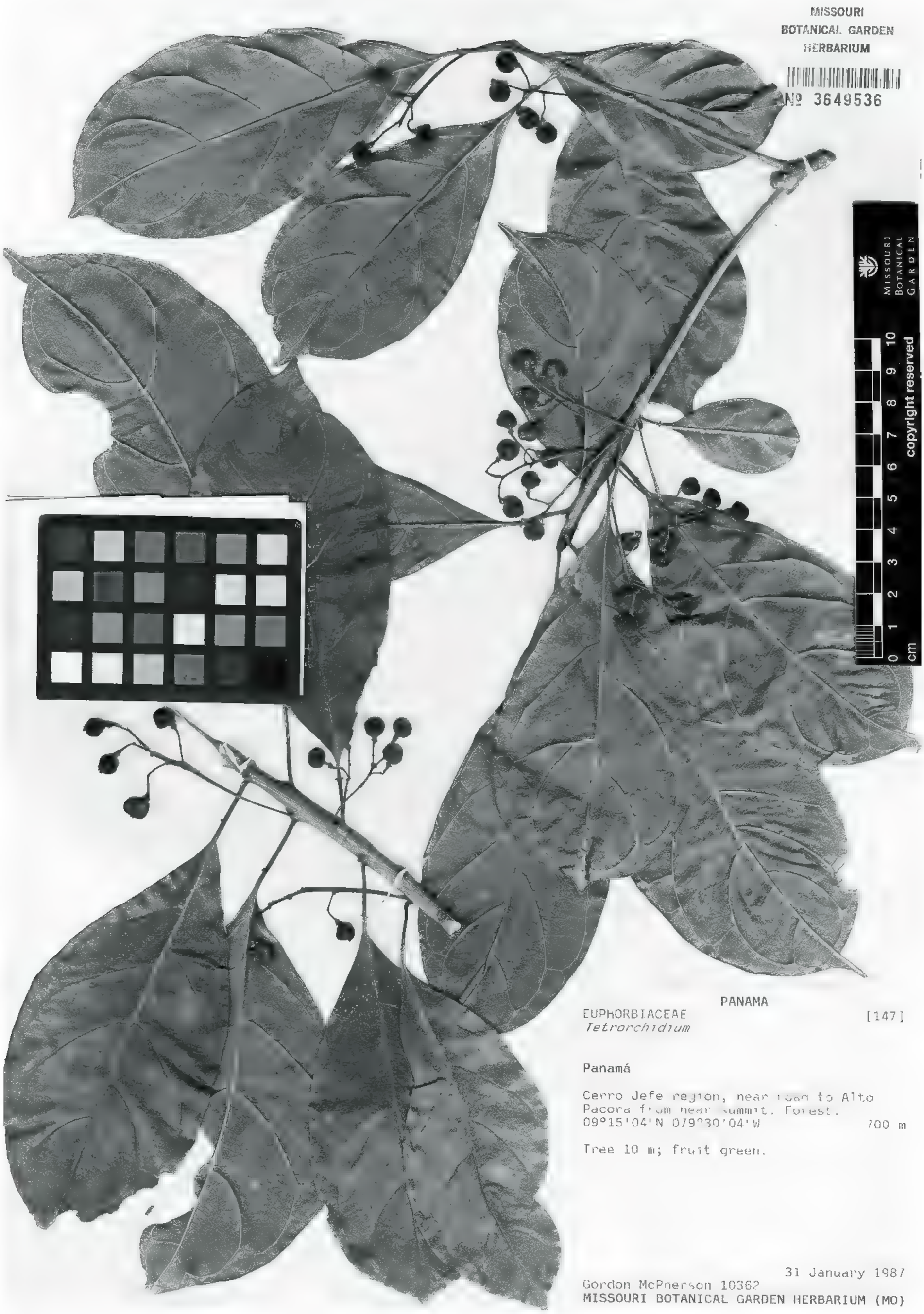

Figure 1. Isotype of *Tetrorchidium trichotocarpum* McPherson (*McPherson 10362*, MO).

chartaceous; base typically cuneate but occasionally obtuse, ultimately narrowly attenuate into petiole; apex acuminate to a narrowly obtuse tip, the acumen 5–10 mm; blade margin entire or more usually subentire because of 1 to 4(5) marginal glands or small glandular teeth per side in addition to the more prominent basal pair of glands, the latter subcylindrical, 0.5–1 mm tall, to 0.5 mm diam., borne near or somewhat below the end of the attenuate base of the blade, occasionally absent or only one gland present;

surfaces discolorous, sparsely pubescent at least along the veins, glabrescent; secondary veins 4 to 6(7) on each side of the midrib, raised abaxially and evident; higher venation evident under the dissecting microscope; petioles channeled adaxially, (7–)11–23(–27) mm, pubescent like the stem, somewhat glabrescent, usually appearing to bear the prominent pair of foliar glands near or at the distal end; stipules 0.5–1 mm, subtriangular, deciduous. Staminate inflorescences 1 to 3 per axil, (1.5–)4–9(–15) cm, pubescent like the stem, raceme-like with 0 to 2 branches to 1 cm near the base, the fascicles of (1 or 2)3 sessile or subsessile flowers borne at intervals of 3–10 mm along the often zigzag rachis, a pair of sessile crater-like or slightly cylindrical bracteal glands ca. 1 mm diam. usually present at the base of some of the fascicles; sepals 3(to 4), ca. 1 mm, pubescent like the stem; stamens 3, anthers glabrous; pistillode minute, glabrous. Pistillate inflorescences 1 to 3 per axil, 1–7(–9.5) cm, pubescent like the stem, raceme-like, 3- to 11-flowered, flowers solitary or occasionally paired; bracteal glands absent or rarely present and subsessile, crater-like, to 1 mm diam.; pedicels (1–)2–13 mm, if over 3–4 mm, then jointed (the proximal portion 1–7 mm and the distal portion 2–7 mm), pubescent; sepals 3, ca. 1 mm, pubescent; disk shallowly cuplike, ca. 1 mm high, glabrous; ovary densely pubescent; stigmas 3, deeply bifid. Fruit 5–6 mm high, 7–9 mm diam., 3-lobed, often slightly stipitate, thinly pubescent; column 3–5 mm long; seeds roughly spherical, ca. 4 mm diam., alveolate, black, the aril-like exotesta red.

Distribution and habitat. *Tetrorchidium trichotocarpum* is endemic to central Panama, and is currently known from Colón and Panamá provinces and San Blas Islands, occurring in rainforests from 5 to 900 m in elevation.

IUCN Red List category. With an estimated extent of occurrence between 5000 and 20,000 km², the new species is assigned to the Vulnerable category, following the IUCN's criterion B1 (IUCN, 2001).

Etymology. The epithet is derived from the Greek "trichotos," meaning "hairy," and "karpos," meaning "fruit," to draw attention to one of the distinguishing attributes of the species.

Paratypes. PANAMA. **Colón:** Río Caimito, 09°01′14″N, 080°40′59″W, 5 m, *G. McPherson 20402* (MO, PMA); divide betw. Río Piña & Rio Media, W of Limon Bay, 09°14′05″N, 079°57′29″W, 100 m, *I. Johnston 1688* (MO); Santa Rita Ridge rd., 1.5 mi. from Transisthmian Hwy., 09°20′N, 079°47′W, *J. Dwyer 9338* (MO); Santa Rita Ridge rd., 4 mi. from Transisthmian Hwy. to Agua Clara weather station, 09°21′00″N, 079°42′30″W, 500 m, *A. Gentry 8841* (MO); Río Guanche, 3–7 km above bridge, 09°29′N, 079°38′W–09°30′N, 079°40′W, 300–700 ft., *B. Hammel 4894* (MO). **Panamá:** trail to Cerro Brewster from Río Pacora valley, 09°20′N, 079°15′W, 670 m, *G. McPherson 7493* (MO, PMA); Cerro Jefe region, ca. 1.5 mi. along Río Pacora rd., 09°15′N, 079°30′W, 750 m, *G. McPherson 8104* (MO, PMA), *8117* (MO, PMA); Cerro Jefé, 09°14′02″N, 079°22′30″W, 700–1000 m, *I. Valdespino 48* (MO); Cerro Jefe, 09°14′02″N, 079°22′30″W, 700–1000 m, *J. Duke 9415* (MO); Cerrro Azul & Goofy Lake, 09°09′58″N, 079°24′45″W, 700-1000 m, *J. Dwyer 7080A* (MO); Cerro Jefe region, 2.5 mi. N of turnoff to radio tower along rd., 09°11′30″N, 079°23′55″W, 2300 ft., *B. Hammel 6300* (MO); alrededores de La Eneida, 09°10′N, 079°20′W, 800–900, *C. Galdames 1961* (MO, PMA); alrededores de Cerro Jefe, 09°12′50″N, 079°23′05″W, 900 m, *C. Galdames 2422* (MO, PMA); alrededores del Lago Goofy, 09°10′00″N, 079°24′59″W, 400 m, *M. Correa 4563* (MO, PMA); 5–10 km NE of Altos de Pacora, 09°17′03″N, 079°18′31″W, 700–800 m, *S. Mori 6058* (MO); 10 km N of Magarita on rd. to Madroño then 3 km W on ridgetop rd., 09°15′25″N, 079°08′04″W, 1800 ft., *B. Hammel 6014* (MO); El Llano Cartí rd., 9.6–11 km from Inter-American Hwy., 09°16′10″N, 078°55′41″W, 1100–1200 ft., *S. Mori 3531* (MO); El Llano Cartí rd., 8 km N of Pan-Am. Hwy., 09°15′32″N, 078°55′52″W, 450 m, *M. Nee 10391* (MO); El Llano–Cartí Hwy., 17–20 km N of El Llano, 09°17′45″N, 078°56′15″W, *R. Dressler 4629* (MO); El Llano–Cartí rd., ca. 18 km from Pan-Am. Hwy., 09°18′40″N, 078°56′40″W, ca. 400 m, *B. Stein 1030* (MO); Serranía de Majé, S of village of Ipetí, 08°53′36″N, 078°30′23″W, 650–800 m, *M. Huft 1689* (MO). **San Blas:** on Kuna divide trail W of Llano–Cartí rd., 09°21′56″N, 078°57′00″W, 250 m, *G. McPherson 11886* (MO, PMA); near Nusigandi on El Llano–Cartí rd., divide trail E of rd., 09°21′56″N, 078°56′40″W, 300–350 m, *G. McPherson 10769* (MO, PMA).

Key to *Tetrorchidium* Species in Panama (Modified from Webster & Huft, 1988)

1a. Stems knobby, the apex densely hirsute or strigose.
  2a. Stems with persistent swollen stipules; leaves < 7 cm long, the paired glands toward the apex of the petiole ..... *T. microphyllum*
  2b. Stems with raised leaf scars, the stipules persistent or not, rarely swollen; leaves usually over 10 cm long, the paired glands near the middle of the petiole ... *T. costaricense*
1b. Stems smooth, the apex appressed-pubescent or glabrous.
  3a. Stem apex glabrous, usually with a glossy resinous coating; pistillate disk of 3 separate narrow elements.
    4a. Pistillate inflorescence axes pubescent; petioles 2–5.5 cm long, the paired glands well below apex ..... *T. rotundatum*
    4b. Pistillate inflorescence axes glabrous; petioles 1–2.5(–3) cm long, the paired glands near or beyond apex ..... *T. brevifolium*
  3b. Stem apex pubescent, not glossy-resinous; pistillate disk shallowly cupular.
    5a. Ovary 3-carpellate, pubescent; stigmas clearly bifid; pistillate pedicels (often jointed) 1–13 mm long; basilaminar glands to 0.5 mm diam., typically slender ..... *T. trichotocarpum*

5b. Ovary usually 2(but sometimes 3)-carpellate, glabrous; stigmas only slightly lobed; pistillate pedicels 0 2 mm long; basilaminar glands > 0.5 mm diam., often swollen ..... *T. euryphyllum*

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Strychnos puberula (Loganiaceae), a New Species from Panama

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ABSTRACT. *Strychnos puberula* McPherson (Loganiaceae) is described as a new species from Panama, differing from the otherwise similar *S. guianensis* (Aubl.) Mart. in its indument of minute hairs, lack of leaf domatia, consistently 4-merous flowers, and short-stipitate, relatively thick-walled fruit.

Key words: IUCN Red List, Loganiaceae, Panama, *Strychnos*.

Specimens of a small-leaved, small-fruited *Strychnos* L. (Loganiaceae) collected in a lowland forest in the Donoso District of Colón Province, Panama, could not be matched to any of the 11 species listed in the *Catálogo de las Plantas Vasculares de Panamá* (Correa et al., 2004) and represent an undescribed species. Very similar to the widespread and variable *S. guianensis* (Aubl.) Mart., the new species contrasts, nevertheless, with that species in small but consistent features of vegetative and fruit morphology, as detailed below. From *S. peckii* B. L. Rob., to which it keys in the *Flora Mesoamericana* generic treatment prepared by A. E. Brant and G. Davidse (2009), the new species differs most conspicuously in having smaller leaves (5.5–10.2 × 2–4.2 cm vs. ca. 15 × 8 cm) and 1-seeded fruits (vs. many-seeded).

Strychnos puberula McPherson, sp. nov. TYPE: Panama. Colón: W part of province, site of proposed copper mine, 08°52′18″N, 080°41′05″W, lowland forest, 150 m, 16 Apr. 2009, collected with J.-Y. Serein, *G. McPherson 21021* (holotype, PMA; isotype, MO). Figure 1.

Species *Strychnoti guianensi* (Aubl.) Mart. similis, a qua indumento breviore, foliorum nervis in axillis domatiis non instructis, floribus 4-meris (vs. 4 vel 5-meris) et fructibus stipitatis (vs. sessilibus) pericarpio in sicco crassiore (ca. 1 mm vs. minus quam 0.5 mm) differt.

Woody vine in canopy trees; branchlets slightly flattened to subterete (the older ones slightly angled), minutely appressed-puberulent, very sparsely lenticellate; tendrils (uncoiled) ca. 7–8 cm, appressed-puberulent; spines absent; interpetiolar line evident. Leaf blades oblong-elliptical to narrowly ovate, 5.5–10.2 × 2–4.2 cm, base obtuse, apex acuminate, 5-plinerved, the basal pair of secondary veins arising at or to 2 mm from the blade base, and the second pair arising (5–)8–12 mm distally; midrib slightly immersed adaxially, prominent abaxially, the secondary and higher order venation very slightly raised adaxially, more evidently raised abaxially; the adaxial surface glabrous except for the base of the midrib, which is appressed-puberulent, the abaxial surface sparsely and very obscurely appressed-puberulent, tufts of hair absent from axils of veins of the abaxial surface; raised portion of stem at base of petiole 1.5–2 mm, appressed-puberulent; petiole 4–6 mm, channeled, appressed-puberulent. Inflorescences axillary, raceme-like, of 5 to 9 flowers, the axis (2–)5–10 mm, appressed-puberulent; bracts and bracteoles ca. 2 mm; pedicels 1–3 mm in flower, 2–4 mm in fruit. Flowers 4-merous; calyx 1–1.5(–2) mm, the sepals united only near the base, the lobes sometimes unequal, ciliate and subglabrous to puberulent abaxially; corolla white, ca. 6.5 mm, tube 3–3.5 mm, lobes 3–3.5 mm, reflexed, papillose (especially distally) on both surfaces, long-pubescent near the base of the lobes adaxially and in the tube; stamens ca. 2 mm, glabrous, the anthers broadly and submedially affixed, ca. 0.8 mm; ovary 1 mm, glabrous; style 6 mm, glabrous. Fruit pale yellow (not fully mature), subspherical, 14–20 mm diam. (dried), but narrowed basally into a foot or pseudopedicel ca. 2 × 2 mm at the base, apiculate distally, glabrous, the dried surface wrinkled and very shallowly tuberculate; fruit wall (dried) 1 mm thick.

Habitat, distribution, and IUCN Red List category. *Strychnos puberula* has been collected in one lowland rainforest of western Colón Province, Panama. Since only the type locality and one other site ca. 5 km away are known, *S. puberula* is assigned the IUCN status of DD or Data Deficient (IUCN, 2001).

Discussion. *Strychnos puberula* strongly resembles some forms of the variable *S. guianensis* in leaf size (4–7 × 1.5–3.1 cm in the latter species) and shape (lanceolate to elliptic in *S. guianensis*), some floral details (subglabrous sepals, subequal corolla lobes and tube), and in its 1-seeded fruit, but differs in that its vegetative indument consists of minute appressed hairs (vs. longer and suberect to erect hairs

Figure 1. Isotype of *Strychnos puberula* McPherson (*McPherson 21021*, MO).

in *S. guianensis*), the axils of its secondary veins are not occupied by tufts of hairs (vs. tuft-domatia present), its flowers are 4-merous (vs. (4)5-merous), and its fruit exhibits a short basal stalk and has a wall thickness, on drying, of 1 mm (vs. fruit rounded-sessile with a wall < 0.5 mm thick). *Strychnos guianensis* is widespread in South America and is also known from the Pacific slope of Costa Rica, whereas *S. puberula* is apparently confined to the Atlantic slope of central Panama.

Paratypes. PANAMA. **Colón:** Donoso, W part of province, site of proposed copper mine, 08°49′28″N, 080°39′29″W, 180 m, *G. McPherson 19761* (MO, PMA); 08°52′18″N, 080°41′05″W, 150 m, *G. McPherson 21020* (MO, PMA).

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A New Genus of Podostemaceae from Venezuela

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Abstract. The new genus *Autana* C. T. Philbrick and species *A. andersonii* C. T. Philbrick are illustrated and described. The new species is documented from four rivers that drain into the Orinoco River, Amazonas, Venezuela. *Autana* is distinguished by three characters that do not occur in other Neotropical Podostemaceae. The upper surface of the flattened stem has an anastomosing pattern that is derived from a continuation of leaf margins. When the capsule is mature, the pedicel apex (and receptacle) is swollen and hollow. After anthesis, locations where the deciduous stamens attached become darkened and shaped like an inverted teardrop. Phylogenetic analyses indicate *A. andersonii* is sister to a clade containing species of *Castelnavia* Tul. & Wedd., *Oserya* Tul. & Wedd., *Noveloa* C. T. Philbrick, and *Rhyncholacis* Tul., as well as upright stemmed species of *Apinagia* Tul., and Central American and Mexican species of *Marathrum* Bonpl.

Resumen. Se ilustran y describen un género *Autana* C. T. Philbrick y una especie *A. andersonii* C. T. Philbrick nuevos. La especie nueva se registra de cuatro ríos que desembocan en el río Orinoco, Amazonas, Venezuela. *Autana* se distingue de otras Podostemaceae por tres caracteres que no se encuentran en ninguna de las otras especies de Podostemaceae neotropicales. La superficie superior del tallo aplanado tiene una figura anostomosada que surge de una continuidad de los márgenes de la hoja. Cuando la cápsula se madura, el ápice del pedicelo (y receptáculo) se hincha y se torna hueco. Los sitios donde los estambres caedizos estaban unidos, se oscurecen y toman la forma de una lágrima invertida. Los análisis filogenéticos indican que *A. andersonii* es hermana de un clado que contiene especies de *Castelnavia* Tul. & Wedd., *Oserya* Tul. & Wedd., *Noveloa* C. T. Philbrick y *Rhyncholacis* Tul., así como de especies con tallos erguidos de *Apinagia* Tul. y de especies centroamericanas y mexicanas de *Marathrum* Bonpl.

Key words: Amazonas, aquatic plants, *Autana*, IUCN Red List, Podostemaceae, Venezuela.

Venezuela exhibits a rich diversity of Podostemaceae. Velásquez (1994) recognized eight genera and 22 species in the country. Philbrick et al. (2010) listed the same genera, but somewhat more (28) species. Berry (2004) reported 26 species for the Venezuelan Guayana alone. Six of the genera documented from Venezuela (*Apinagia* Tul., *Jenmaniella* Engl., *Marathrum* Bonpl., *Mourera* Aubl., *Oserya* Tul. & Wedd., *Rhyncholacis* Tul.) represent the subfamily Podostemoideae, while two otherwise occur in the Weddellenoideae (*Weddellina* Tul.) or Tristichoideae (*Tristicha* Thouars) (Royen, 1951, 1953, 1954). The current contribution adds an additional genus to Venezuelan Podostemaceae.

While conducting field studies along tributaries of the Orinoco River (Venezuela, Amazonas), specimens were collected that did not correspond to any of the presently recognized species or genera in the Podostemaceae. The new taxa described here belong to the Podostemoideae based on the presence of a spathella surrounding the flower, a 2-carpellate ovary, two stigmas, and distichous leaves. Molecular studies (ITS, *rbcL*, *trnL*) of Neotropical Podostemaceae indicate that the new species is distinct from all other taxa in subfamily Podostemoideae (Tippery et al., 2011, listed as "Autana," see below). Conse-

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quently it is placed into a newly recognized monotypic genus.

In the description for the new species, descriptive ranges are given as (minimum) median (maximum). Collection localities were analyzed in ArcMap 9.3 (ESRI, 2009), and river systems were mapped using geospatial rivers data from The Americas Base Map (Bletter et al., 2004). Specimen data coordinates were assumed to be in the World Geographic System (WGS) 1984. The extent of occurrence (EOO), a criterion used for IUCN Red List analysis (IUCN, 2009) to measure the area of a minimum convex polygon drawn around a set of occurrences, was calculated with Hawth's Tools Minimum Convex Polygon tool (Beyer, 2004), in the South America Albers Equal Area Conic coordinate system.

Autana andersonii C. T. Philbrick, gen. et sp. nov. TYPE: Venezuela, Amazonas: Río Autana, 4.7660°N, 67.4567°W, 60 m, 5 Jan. 2006, *C. T. Philbrick, A. Novelo R. & C. Lasso 5862* (holotype, VEN; isotypes, CAR, MO, WCSU). Figure 1.

Genus novum *Apinagiae* Tul. simile, sed ab ea caulibus applanatis supra cristulis anastomosantibus e foliorum marginibus oriundis instructis, apicibus pedicellorum inflatis cavisque et staminum caducorum ad receptaculum locis insertionis fuscatis obovoideisque differt.

Aquatic herbs, presumed perennial, attached to rocks in river rapids and waterfalls; roots not seen; stems prostrate or upright, the flattened stems repeatedly dichotomously or subdichotomously branched, (4–)12(–39) × (1.5–)4(–15) mm, with anastomosing pattern on upper surface derived from fused petiole margins, anastomosing pattern darkened and obscured as stem dries; the upright stems oval to slightly flattened. Leaves marginal on stems, to 3 m long, distichous, dithecous, bipinnately compound, circinate, petiolate; petioles (1.8–)9.8(–36.8) cm, oval to flattened when young, oval to terete at maturity, gradually tapering apically; petiole margins with membranous stipules when young, quickly falling, margins of adjacent leaf petioles fused, forming darkened, slightly raised ridges that form an anastomosing pattern on the stem; each pinna with 3 or 4 pinnules; petiolules (2–)15.5(–82) mm; pinnae at base of leaf (1.5–)5.5(–25.6) mm long, near middle of leaf (0.5–)4.3(–21.1) mm, near apex of leaf (0.5–)2.4(–11) mm; ultimate leaf divisions terete, (0.1–)0.6(–2.6) mm × (20–)60(–140) μm, arising alternately along central axis or dichotomously-subdichotomously divided. Flowers numerous, marginal or submarginal on the flattened stems, arising solitary in pockets between leaf bases, hermaphroditic, actinomorphic, oriented vertically, pedicellate; pedicels in pre-anthesal flowers (1.2–)5.2(–22) mm long; covered by saclike spathellae, the spathella (3.6–)7.6(–12) × (1.1–)1.8(–2) mm, clavate, smooth, rupturing apically or subapically into 2 to 5 segments as pedicels elongate during anthesis. Tepals (5 to)7(to 9), (0.6–)2.1(–2.9) mm, arising between stamen filaments, linear, acute. Stamens in complete whorl around ovary, (5 to)7(to 9), anthers triangular, (0.7–)1.7(–2.2) × (0.3–)0.5(–0.7) mm at base, introrse, the thecae apices fused; filaments flattened to oval in cross section, attaching to anther in a pocket-like area, widest at base, (0.5–)1.8(–2.4) mm in post-anthesal flowers; pollen tricolpate, polar axis (15–)19(–22) μm wide; ovaries (1.2–)2.2(–2.6) × (0.6–)1.3(–1.9) mm, globose, with a medial longitudinal line from base to apex; stigmas 2, (0.1–)0.4(–0.9) mm, linear, widest at base, fused for most of length, distinct apically for < 0.2 mm, falling after anthesis. Capsules (1.3–)3(–4.1) × (1.1–)1.4(–1.9) mm, slightly flattened perpendicular to suture margin, valves 2, persistent, each with 5 non-suture ribs, suture margins also riblike, pedicellate; pedicels (0.4–)3.9(–5.8) cm × (0.6–)1.1(–1.4) mm, hollow at maturity, apex (receptacle) swollen and hollow, swollen portion extending (1.2–)4(–8) mm down pedicel, inverted teardrop-shaped recessed marks (or holes) where stamen filaments attached on swollen pedicel apex (0.2–)0.6(–1) × (0.1–)0.2(–0.3) mm; seeds (53 to) 103(to 169) per capsule, (0.2–)0.3(–0.4) × (0.1–) 0.2(–0.3) mm, orange to brown, obovate.

Etymology. The genus name is taken from the Autana River, Amazonas, Venezuela, where the species was first collected (cf. Art. 20.1, McNeill et al., 2006). The specific epithet is in honor of Gregory J. Anderson (1944–), University of Connecticut, who played a central role in the professional development of the first author.

Distribution and IUCN Red List category. *Autana andersonii* is known from four rivers that drain into the Orinoco River (Fig. 2). The species is common where it occurs. The extent of occurrence (IUCN, 2009) of the species is estimated at 5400 km². The species is categorized as Vulnerable (VUA1cB1), using the IUCN Red List criteria (IUCN, 2009). Factors that make species of Podostemaceae particularly vulnerable to human impacts are discussed in Philbrick et al. (2010).

Additional observations. The genus level classification of much of Neotropical Podostemaceae remains questionable (e.g., Royen, 1951; Berry, 2004; Tippery et al., 2011). Phylogenetic analyses have revealed that

some presently recognized genera do not reflect natural evolutionary groups, i.e., are not monophyletic (reviewed in Tippery et al., 2011). Tippery et al. (2011), in their study of molecular and morphological characters, have shown that one strongly supported clade includes all sampled species from three genera (*Jenmaniella*, *Lophogyne* Tul., *Monostylis* Tul.), but only a subset of species from two others (*Apinagia*, *Marathrum*). This well-supported clade lacks apparent morphological synapomorphies.

Discussion. Tippery et al. (2011) reported that *Autana* aligned sister to a clade composed of a portion of the genera *Apinagia* and *Marathrum*, as well as species of *Oserya*, the newly recognized *Noveloa* C. T. Philbrick, *Castelnavia* Tul. & Wedd., and *Rhyncholacis* (see Tippery et al., 2011, for details). Moreover, *Autana* was not placed with species in other genera, i.e., with species of *Apinagia* and *Marathrum* not included in the large clade listed above, nor with *Jenmaniella*, *Monostylis*, *Lophogyne*, *Mourera*, and *Podostemum* Michx. Consequently, the species is placed in its own monotypic genus.

Several morphological characters are distinctive for *Autana andersonii*. The flattened prostrate stem has a unique anastomose pattern on the upper surface (Fig. 1A, B). This stem pattern is comprised of darkened, slightly raised ridges that represent extensions of the fused petiole margins of adjacent leaves. When the plant dies after being exposed by lowering water levels, the entire stem darkens and the anastomosing pattern can then be obscured. Three features associated with reproductive structures are also distinct. One relates to the stigmas; the others pertain to the fertile pedicels. All species of Neotropical Podostemaceae subfam. Podostemoideae (e.g., species of *Apinagia*, *Jenmaniella*, *Macarenia* P. Royen, *Marathrum*, *Oserya*, *Rhyncholacis*) have two stigmas. For most species, the stigmas are free for the majority of their length, fused only at the base. In contrast, the two stigmas of *A. andersonii* are fused for most of their length, with only a short segment (< 0.2 mm) free at the apex.

The pedicel of most Podostemoideae elongates during anthesis, thus resulting in the mature capsule projecting well past the ruptured spathella, e.g., species of *Apinagia*, *Marathrum*, and *Rhyncholacis*. In contrast, the capsule of species of *Castelnavia* and *Cipoia* C. T. Philbrick, Novelo & Irgang remains inside the ruptured spathella, as the pedicel does not elongate (e.g., Philbrick et al., 2009). *Autana andersonii* possesses an elongated pedicel when in fruit.

Features of the mature pedicel apex (receptacle) are distinctive for *Autana andersonii*. Hollow pedicel apices, when capsules are mature, are common in Neotropical Podostemaceae (e.g., *Autana*, *Apinagia*, *Jenmaniella*, *Marathrum*, *Monostylis*, *Rhyncholacis*). In most genera, the pedicel apex gradually expands apically, or is barely expanded at all. In contrast, the mature pedicel apex of *A. andersonii* and some species of *Marathrum* (e.g., *M. utile* Tul.) and *Rhyncholacis* (e.g., *R. penicillata* Matthiesen) is abruptly expanded. When this occurs in *Marathrum* and *Rhyncholacis*, the expanded pedicel apex is cup-shaped (concave). In contrast, *A. andersonii* has an expanded pedicel apex that convexly develops and is obovate in outline when viewed laterally. Moreover, the demarcation between the expanded pedicel apex and the capsule base is distinguished by a narrowed region (Fig. 1I, J).

The location where stamen filaments attach is a conspicuous feature on the expanded pedicel apex of *Autana*. In *A. andersonii* the stamen filaments fall away soon after anthesis, which is common in Podostemaceae. The location where a stamen had attached to the pedicel, however, develops into a recessed darkened area shaped like an inverted teardrop (widest apically, narrowed basally) (Fig. 1I, J). These areas are distinctive, and as the capsule matures they often break down and form holes; one can see into the inflated hollow pedicel apex via these holes. The capsules often persist for several months (or between seasons) and the holes in the pedicels become prominent. Consequently, such features associated with the mature capsules (expanded, hollow pedicel apex with holes) are a reliable way to identify *A. andersonii* long after the plant has died back after being exposed by lowering water levels.

The stem orientation of *Autana andersonii* is incompletely known. Collections of the species that included living material (i.e., the type *Philbrick et al. 5862* and paratypes *Philbrick et al. 5860* and *5861*) possessed stems attached to the substratum throughout their ventral surfaces; they were prostrate. Three paratype collections (*Philbrick et al. 5875*, *5863*, and *6318*), however, possessed some stems that may have had a single basal attachment point to the substratum, and these stems could be either upright or pendant. The three latter collections were comprised of dried stems, and mature capsules that had been exposed by lowering water levels.

Paratypes. VENEZUELA. **Amazonas:** Río Autana, 4.8022°N, 67.4861°W, 60 m, 4 Jan. 2006, *Philbrick, Novelo & Lasso 5860*, *5861* (CAR, MO, VEN, WCSU); Río Sipapo, 4.8155°N, 67.7293°W, 6 Jan. 2006, *Philbrick, Novelo & Lasso 5863* (CAR, MO, VEN, WCSU); Río Cuao, Raudal del Dante, 5.0442°N, 67.5605°W, 6 Jan. 2006, *Philbrick, Novelo & Lasso 5867* (CAR, MO, VEN, WCSU); Río Cuao, Raudal del Dante, 5.0442°N, 67.5605°W, 17

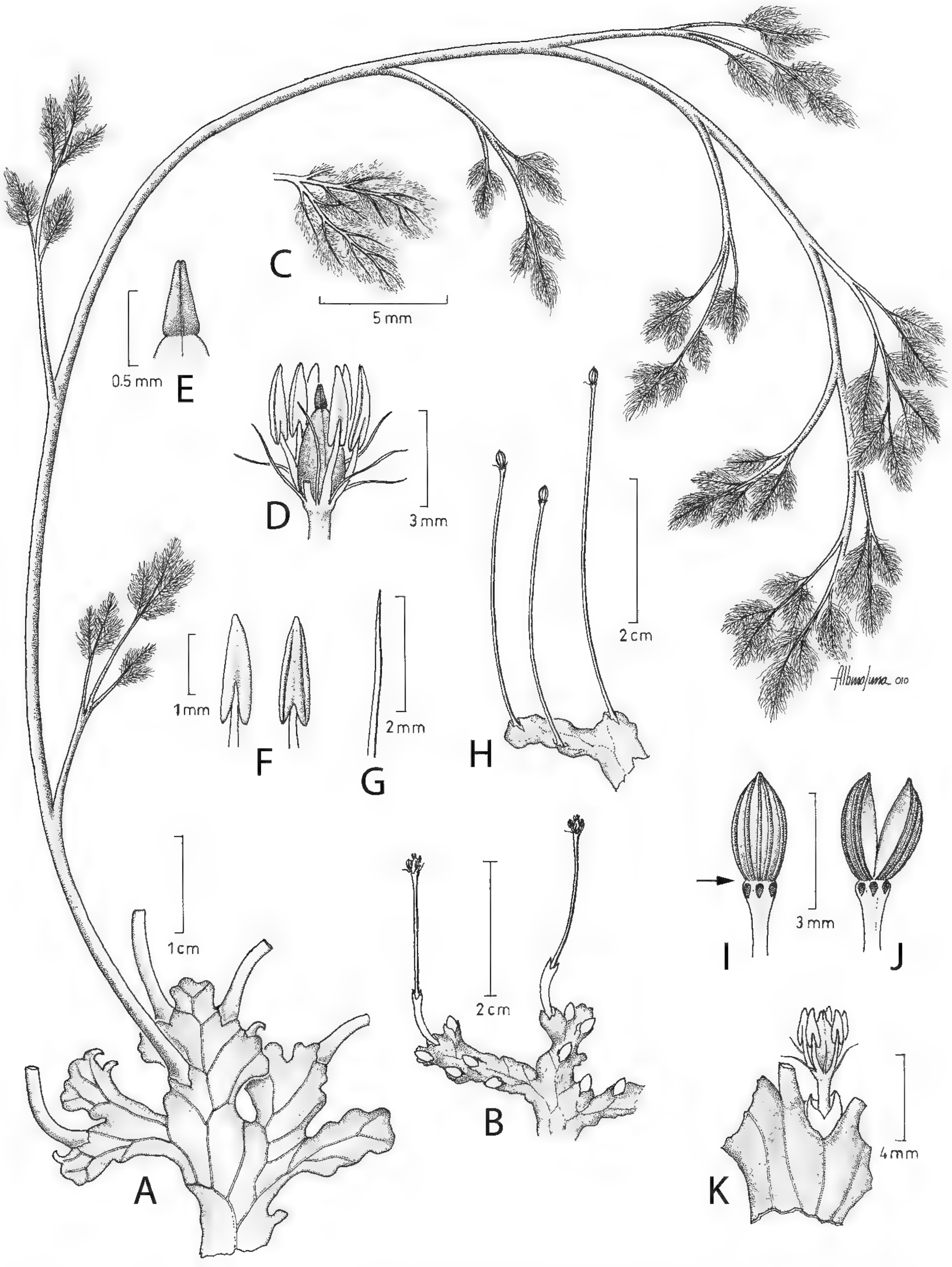

Figure 1. Vegetative and reproductive features of *Autana andersonii* C. T. Philbrick. —A. Portion of branched, flattened, prostrate stem viewed from above with four leaf bases and one complete pinnately compound leaf. Note anastomosing pattern on stem. The entire leaf illustrates the prominent petiole, the acropetally shortened internodes, with most pinnae having three pinnules. —B. Constricted portion of branched, flattened, prostrate stem after drying. Twelve flowers are shown, with two ruptured through the spathella and projected on prominent pedicels. Ten flowers remain enclosed within intact spathellae. —C. Detail of segment of pinnule showing dichotomously to subdichotomously divided penultimate divisions. —D. Open flower showing apical portion of pedicel, six stamens, six tepals, and the ovary and erect stigmas that are laterally fused for most of their length. One stamen has been removed. —E. Detail of the two fused, rigid stigmas. —F. Proximal (right) and distal (left) views of stamen showing apex of filament and two thecae fused apically. A linear zone of introrse dehiscence is seen proximally, at right.

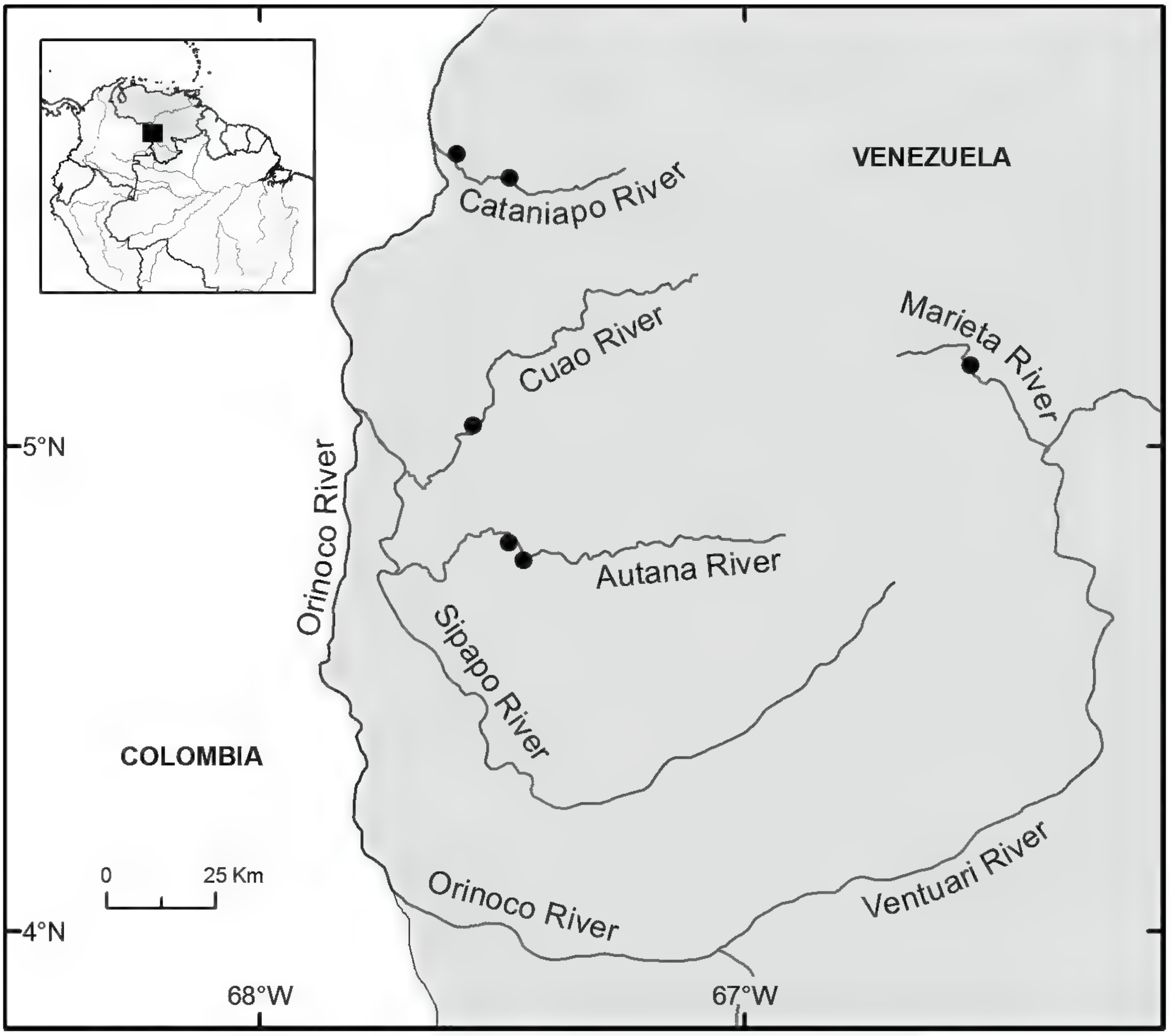

Figure 2. Region of northwestern South America (see inset map) emphasizing the northwestern part of the state of Amazonas, Venezuela. Only principal rivers are noted. Locations from which *Autana andersonii* has been collected (Autana, Cataniapo, Cuao, and Marieta Rivers) are indicated with solid circles.

Jan. 1949, *Maguire & Politi 28400* (NY); Puerto Ayacucho, Río Cataniapo, ca. 15 km E of main rd., 5.5548°N, 67.4856°W, 9 Jan. 2006, *Philbrick, Novelo & Lasso 5878* (CAR, MO, VEN, WCSU); Puerto Ayacucho, Río Cataniapo, at bridge along rd. to Samariapo, 5.6034°N, 67.5937°W, 9 Jan. 2006, *Philbrick, Novelo & Lasso 5875* (CAR, MO, VEN, WCSU); Canyo Marieta, ca. 1 hr. by boat upstream of confluence with Río Ventuari, 5.1687°N, 66.5334°W, 8 Mar. 2009, *Philbrick, Fort & Perrez 6318* (VEN, WCSU).

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←

—G. One acute tepal. —H. Three mature capsules projecting from margins of flattened stem. —I. Mature indehiscent capsule and upper portion of pedicel. Note swollen pedicel apex, narrowed region between pedicel apex and capsule base (arrow), and inverted teardrop-shaped holes near pedicel apex. Holes occur where stamen filaments had attached. —J. Mature dehisced capsule and upper portion of pedicel. Note swollen pedicel apex, the distinctive/characteristic inverted, teardrop-shaped holes, and two persistent capsule valves. —K. Portion of prostrate stem with one flower projecting from a pocket located between two leaf bases. Note dark lines that span the flattened stem where two leaf bases meet. A, C, H–K are based on the holotype *Philbrick et al. 5862* (VEN); B from *Philbrick et al. 5867* (WCSU); D–G from *Philbrick et al. 5875* (WCSU).

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Gouania tiliifolia: The Correct Name for *Gouania scandens*

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Abstract. In a recent revision of *Gouania* Jacq. (Rhamnaceae) for Madagascar and other western Indian Ocean islands, confusion about the correct date of publication of Lamarck's *Encyclopédie Méthodique* caused the authors to overlook the nomenclatural priority of *G. tiliifolia* Lam. over the heterotypic synonym *G. scandens* (Gaertn.) R. B. Drumm. The error is corrected, and the new combination *G. tiliifolia* subsp. *glandulosa* (Boivin ex Tul.) Buerki, Phillipson & Callm. is provided for its non-typical subspecies.

Resumé. Lors de la récente révision du genre *Gouania* Jacq. (Rhamnaceae) à Madagascar et incluant les autres îles de l'Océan Indien occidental, une confusion sur la date exacte de publication de *l'Encyclopédie Méthodique* de Lamarck a eu pour conséquence une omission dans la priorité nomenclaturale de *G. tiliifolia* Lam. sur le synonyme hétérotypique *G. scandens* (Gaertn.) R. B. Drumm. Cette erreur est corrigée et la nouvelle combinaison *G. tiliifolia* subsp. *glandulosa* (Boivin ex Tul.) Buerki, Phillipson & Callm. est proposée pour sa sous-espèce non-typique.

Key words: Comoros, *Encyclopédie Méthodique*, *Gouania*, Lamarck, Madagascar, Mascarenes, Rhamnaceae.

During the final stages of editorial review of our recently published revision of the genus *Gouania* Jacq. (Rhamnaceae) for Madagascar and the other western Indian Ocean islands (Buerki et al., 2011), a query was raised about the correct dates of publication of Lamarck's *Encyclopédie Méthodique, Botanique*. This work, which was published in eight volumes (each comprising one or two parts) between 1783 and 1808, contained descriptions of five species of *Gouania* in the first part of Volume 3, four of which were described for the first time. Of these, two species, *G. mauritiana* Lam. and *G. tiliifolia* Lam, occur in the region concerned. After careful checking in relevant bibliographic literature (Britten, 1906; Stafleu & Cowan, 1979) we established that the correct date of publication was 1789 and not 1792 as we had originally stated in our manuscript. Unfortunately, we failed to notice that this correction to the date of publication caused the name *G. tiliifolia* to have priority over the name *G. scandens* (Gaertn.) R. B. Drumm., which was published in 1791 (based on *Retinaria scandens* Gaertn.). We regard the two taxa to be conspecific, and therefore the first objective of this article is to reinstate *G. tiliifolia* as the correct name for this species. Furthermore, we regard this species to comprise two subspecies differing in only minor morphological characters, but with distinct areas of distribution. We published the new combination *G. scandens* subsp. *glandulosa* (Boivin ex Tul.) Buerki, Phillipson & Callm. (based on *G. glandulosa* Boivin ex Tul.) to accommodate the material from Madagascar with slightly different leaves and stipules and longer floral disc lobes, in comparison with *G. scandens* subsp. *scandens* from the Mascarenes. The second objective of this article is therefore to publish the necessary new combination for the plant from Madagascar as a subspecies of *G. tiliifolia*.

Gouania tiliifolia Lam. Encycl. (Lamrack) 3: 5. 1789, as "*tiliaefolia*," non *Gouania tiliifolia* Rottb. ex DC., 1825, nec *Gouania tiliifolia* Roxb., 1795 [= *Gouania microcarpa* DC.]. TYPE: [Réunion Island]. Île Bourbon, s.d. (fl.

& fr.), *Commerson s.n.* (lectotype, designated by Buerki et al. [2011: 188], P-LA!; isolectotype, G!).

Gouania scandens (Gaertn.) R. B. Drumm., Fl. Zambes. 2: 435. 1966. Basionym: *Retinaria scandens* Gaertn. Fruct. Sem. Pl. 2: 187, tab. 120, fig. 4. 1791. *Retinaria volublis* Gaertn., Fruct. Sem. Pl. 2: 187, tab. 120, fig. 4. 1791. nom. superfl. *Gouania retinaria* DC., Prod. (DC.) 2: 40. 1825, nom. superfl. TYPE: [Mauritius] tab. 120, fig. 4 in Gaertn., 1791: 187 (lectotype, designated by Drummond [1966: 435, tab. 120, fig. 4] in Gaertner [1791: 187]).

Gouania tiliifolia Lam. subsp. **glandulosa** (Boivin ex Tul.) Buerki, Phillipson & Callm., comb. nov. Basionym: *Gouania glandulosa* Boivin ex Tul., Ann. Sci. Nat., Bot., sér. 4, 8: 129. 1857 [as "*Guania*"]. *Gouania scandens* (Gaertn.) R. B. Drumm. subsp. *glandulosa* (Boivin ex Tul.) Buerki, Phillipson & Callm. Ann. Missouri Bot. Gard. 98(2): 190. 2011. TYPE: Madagascar. Toamasina: Sainte-Marie, 1834 (fr.), *A. Bernier 239* (lectotype, designated by Buerki et al. [2011: 190], P 00386394!).

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Una Especie Nueva de *Combretum* (Combretaceae, sección *Combretum*) de la Costa del Occidente de México

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Resumen. Se describe como especie nueva a *Combretum igneiflorum* Rendón & R. Delgad. (Combretaceae), de la costa del Occidente de México, de los estados de Jalisco y Colima. Es parecida morfológicamente a *C. assimile* Eichler de Centro y Suramérica pero se distingue por tener hojas, flores y frutos de menor tamaño, por espigas que no sobrepasan la longitud de las hojas, pecíolo lepidoto, por lo general piloso y frutos con alas estrechas.

Abstract. *Combretum igneiflorum* Rendón & R. Delgad. (Combretaceae) is described as a new species from the coast of western Mexico, from the states of Jalisco and Colima. It is morphologically similar to *C. assimile* Eichler from Central and South America, but is distinguished by the smaller size of the leaves, flowers, and fruits, the spikes that do not exceed the length of the leaves, the lepidote petiole, the general pilosity, and the fruits with narrow wings.

Key words: Colima, Combretaceae, *Combretum*, IUCN Red List, Jalisco, western Mexico.

La familia Combretaceae R. Br. comprende 20 géneros y alrededor de 500 especies con una distribución cosmopolita, sobre todo tropical. *Combretum* Loefl. es el género más diverso con 255 especies, 30 de ellas en América; desde México hasta el norte de Argentina y Las Antillas (Stace, 1997). Engler y Diels (1899, en Stace, 1969) agruparon las especies de *Combretum* en 55 secciones, 11 de ellas americanas. Por su parte, Exell (1953) y Stace (1969) reconocieron respectivamente 11 y 13 secciones en América, basándose en la morfometría de las escamas foliares. De acuerdo con Rendón-Sandoval (2009) en el Occidente de México se desarrollan las especies: *C. decandrum* Jacq. (secc. *Spinosae* Exell), *C. laxum* Jacq. (secc. *Combretastrum* Eichler), *C. farinosum* Kunth y *C. fruticosum* (Loefl.) Stuntz (secc. *Combretum* Exell, de acuerdo con Stace [1969]).

De Chamela, Jalisco, Lott (1993) enlistó una probable especie nueva que corresponde con esta propuesta. Dentro del grupo de la sección *Combretum* se propone la especie que a continuación se describe.

Combretum igneiflorum Rendón & R. Delgad., sp. nov. TIPO: México. Jalisco: La Huerta, Careyes, terrenos del Fraccionamiento Careyes, Km 53.5 de la carretera México 200, entre Melaque y Chamela, UTM 496433 E, 2150640 N, 79 m, Bosque Tropical Caducifolio, 28 jun. 2009 (fl.), *F. J. Rendón-Sandoval, R. Ramírez-Delgadillo, A. Frías-Castro & A. Castro-Castro 284* (holotipo, IBUG; isotipos, IEB, MEXU, MO, XAL, ZEA). Figura 1.

Haec species *Combreto assimili* Eichler similis, sed ab eo foliis floribus fructibusque minoribus, spicis folia non superantibus, petiolo lepidoto plerumque piloso, petalis ad apicem ciliatis atque fructu ellipsoideo lepidoto viridi-luto brunneove anguste 4-alato distinguitur.

Bejucos de crecimiento indeterminado o arbustos escandentes de ca. 3 m de altura; tallos inermes, teretes, de lisos a fisurados, huecos, con los nudos un poco ensanchados. Hojas simples, opuestas; láminas de lanceoladas a elíptico-ovadas, 4–15 × 1.5–5.5 cm, papiráceas, margen entero; indumento lepidoto de escamas peltadas, de translúcidas a amarillentas, diminutas, de ca. 0.5 mm de diám., esparcido en el haz, denso en el envés; como defensa ocasional secretan cristales de oxalato de calcio, de ca. 1 mm, aciculares, plateado-translúcidos; nervaduras primaria y secundarias conspicuas, terciarias inconspicuas, amarillentas; por lo general pilosas en el envés, cubiertas por escamas peltadas de color amarillo-dorado con el centro rojizo, ápice de agudo a acuminado, base de redondeada a obtusa; pecíolo 3–12 mm, acanalado y por lo general denso-piloso, con escamas peltadas de color amarillo-dorado con el

† Este artículo está dedicado a la memoria de Raymundo Ramírez Delgadillo (1963 2011), un ejemplo de persona bondadosa y fraterna, amante de las plantas tropicales del Occidente Mexicano y entusiasta de su conocimiento y enseñanza.

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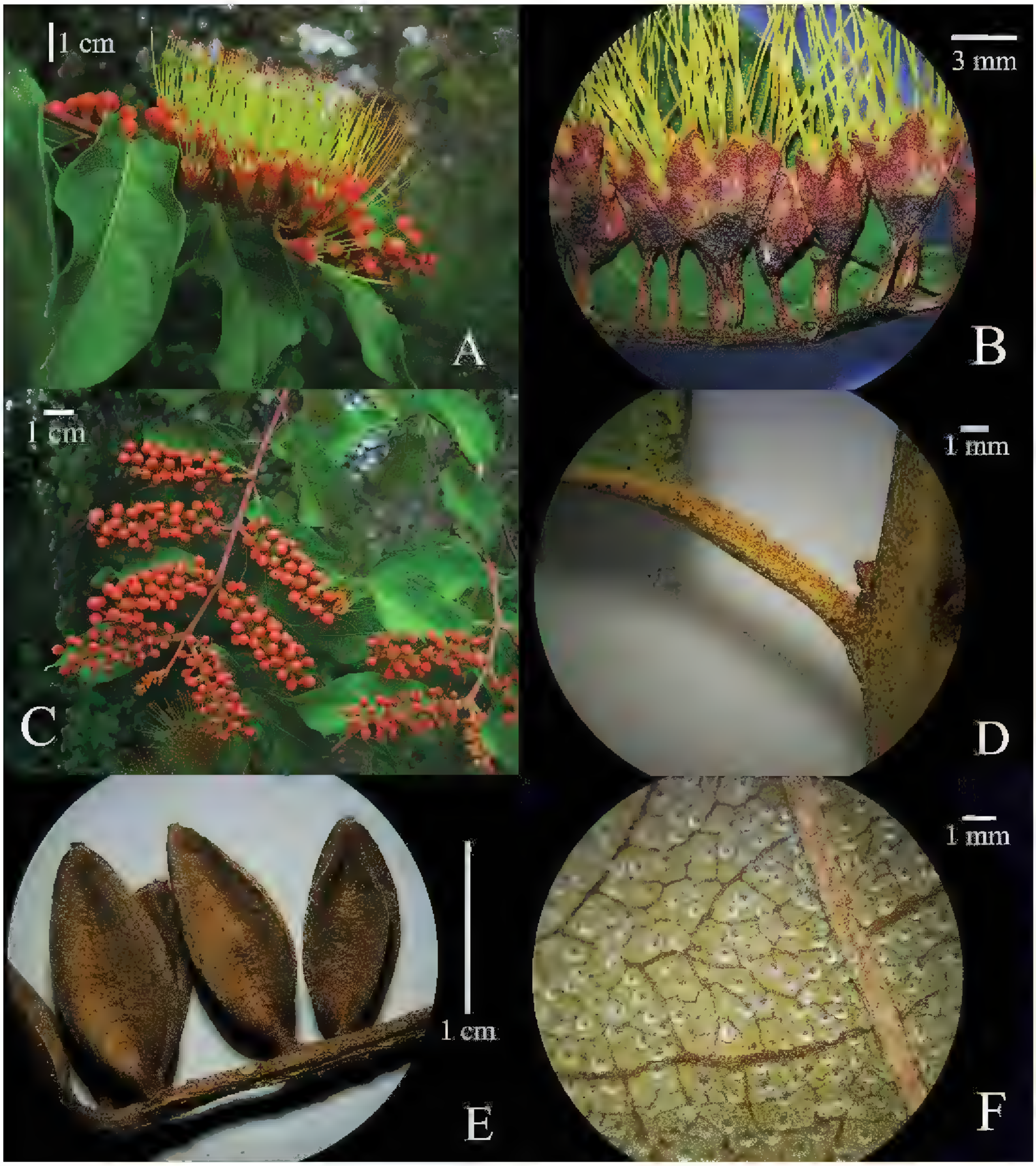

Figura 1. *Combretum igneiflorum* Rendón & R. Delgad. —A. Espiga en floración. —B. Flores. —C. Racimo de espigas en botón. —D. Pecíolo lepidoto y piloso. —E. Frutos. —F. Escamas del envés foliar. A–D, F: fotografías del holotipo, *F. J. Rendón-Sandoval, R. Ramírez-Delgadillo, A. Frías-Castro & A. Castro-Castro 284* (IBUG); E: *F. J. Santana M. & N. Cervantes A. 642* (IBUG).

centro rojizo, densas; ramillas terminales con este mismo indumento, pero de denso a esparcido; yemas supra-axilares de ca. 1 mm, en la base del pecíolo, de suborbiculares a piramidales, pilosas y lepidotas. Inflorescencias en espigas laterales o racimos de espigas terminales; 3 a 7 pares de espigas, 3.5–12 cm, no sobrepasan la longitud de las hojas, secundifloras, en forma de escobillón, pilosas, de color rojo encendido, con escamas amarillo-doradas con el centro rojizo, densas; botones 6–12 × 3–5 mm, de color rojo intenso hacia el ápice, la parte media amarilla y verde hacia la base, con escamas peltadas rojas y amarillo-doradas con el centro rojizo, densas. Flores 20–50 mm (incluyendo los estambres y el estilo), vistosas, nectaríferas, sésiles; hipanto distal cupuliforme, 4–11 × 4–7 mm, rojo-anaranjado hacia el ápice, amarillo-verdoso hacia la base, cubierto por escamas de rojas a amarillo-doradas con el centro rojizo, densas; el margen de la cara interna amarillento-translúcido, la parte media roja y pardo

hacia la base; hipanto basal 3–6 mm, amarillento, verde hacia la base cuando maduro, pardo hacia la base al secar, lepidoto; sépalos 4, deltoides, con el margen pilosuloso; pétalos 4, de elípticos a obovados, a veces espatulados, 1.5–2 × 0.7 mm, reducidos, amarillos cuando jóvenes, de anaranjados a rojizos al madurar, intercalados con los sépalos, pueden ser más cortos, igualar o superar la longitud de estos últimos, el margen del ápice puberulento, algunas veces con escamas esparcidas; estambres 8, largos, exertos, inflexos en el botón, insertos en la porción media de la cara interna del hipanto distal; filamentos lineares, 15–28 mm, de color amarillo-verdoso a amarillo intenso cuando jóvenes, a anaranjado-rojizo al madurar; anteras versátiles, 1.2 × 0.5 mm, rojas; estilo 16–45 mm, inflexo en el centro del botón, de mayor longitud que los estambres, pocas veces los sobrepasa por más de 1 cm, del mismo color que estos últimos, brillante, emerge antes que los estambres. Frutos sámaras de lanceoladas a elipsoides, 13–26 × 6–8 mm, subsésiles, de color verde-amarillento con los bordes rojizos cuando maduros a pardos al secar, con escamas peltadas de color amarillo-dorado con el centro rojizo, densas, provistos de 4 alas estrechas, de ca. 2 mm de ancho; semilla elíptica, 10–14 × 4–5 mm, con 4 surcos longitudinales, testa de color pardo oscuro, una por fruto.

Distribución y hábitat. *Combretum igneiflorum* es endémica del Occidente de México. Hasta ahora sólo se ha colectado en Jalisco y Colima. Se desarrolla en el Bosque Tropical Caducifolio cerca de la costa del Pacífico, a una altitud de 22 a 360 m.s.n.m.

Categoría de la Lista Roja de UICN. Se identifica como la principal amenaza actual, a la destrucción y modificación del hábitat a causa del desarrollo de infraestructura inmobiliaria y turística en la Costa del Occidente de México. El hábitat adecuado para la supervivencia de esta especie se encuentra en sitios próximos a ríos y arroyos. En cuanto al tamaño de población total de la planta, las poblaciones conocidas se distribuyen en los estados de Colima y Jalisco; cerca de la brecha a Peña Blanca, Manzanillo, Colima, se encuentra una población con abundantes frutos maduros, aunque se desconoce el número de individuos que la compone. Al norte de Villa del Mar, Cabo Corrientes, Jalisco, hay una población con flores, pero se desconoce el número de individuos maduros existentes. En el municipio de La Huerta, Jalisco, se conocen poblaciones de tres localidades: (1) Chamela. (en el "Bosque de la Enseñanza" de la Estación de Biología de la UNAM); una población con un solo un individuo maduro en floración, mientras que el resto (numerosos individuos, aproximadamente 50) están inmaduros, muy jóvenes y/o estériles, es decir, se presentan en estado vegetativo. Hay además, algunas otras poblaciones de individuos con flores, pero en donde se desconoce el número de individuos por población. (2) Tenacatita. Se conoce una población de ca. 10 individuos maduros, en donde se han observado con flores y frutos. (3) Careyes. Se observaron de tres a 12 poblaciones en su mayoría conformadas por un solo individuo. Se observó una población con un individuo floreciendo. De dos a cinco de las otras poblaciones presentaron botones florales y de seis a 12 poblaciones presentaron un estado vegetativo. La información disponible se considera como Datos Insuficientes (DD) para la aplicación confiable de alguna categoría de la Unión Internacional para la Conservación de la Naturaleza (UICN, 2001).

Fenología. Florece de (junio) septiembre a noviembre (diciembre) y fructifica de noviembre a diciembre (enero).

Interacciones biológicas. Las flores son visitadas por colibrís, así como por himenópteros (abejas y avispas; obs. pers.). En un individuo que crece en Careyes, Jalisco, se observaron hormigas *Anoplolepis gracilipes* Smith forrajeando en la planta; obtienen el néctar como alimento y no desempeñen una función como polinizadores, sino como robadores.

Etimología. El epíteto "igneiflorum" hace referencia a la coloración que va de amarillo a rojo encendido de las flores, lo cual recuerda al fuego. Se puede reconocer como el *Combretum* de las flores de fuego.

Nombres locales. "Cepillo" y "peineta" (*R. Ramírez-Delgadillo & J. Espíndola 7301*, IBUG). En el área de distribución de *Combretum igneiflorum* en los estados de Jalisco y Colima, cohabitan las especies *C. farinosum* y *C. fruticosum* con las que podría confundirse. Sin embargo, estas últimas difieren por tener hojas no pilosas y frutos con alas amplias, de más de 4 mm de ancho. La especie más parecida a *C. igneiflorum* es *C. assimile* de Centro y Suramérica, pero se diferencia de esta por tener hojas, flores y frutos de menor tamaño, espigas que no sobrepasan la longitud de las hojas, pétalos puberulentos en el margen del ápice, pecíolo lepidoto, por lo general piloso y frutos elípticos de verde-amarillentos con tonos rojizos a pardos, con alas estrechas, de ca. 2 mm de ancho. Stace (1997) mencionó que *C. assimile* se distingue de otros miembros de la sección *Combretum* en Mesoamérica, por las flores y frutos más grandes y rojos; caracteres que no concuerdan con aquellos de *C. igneiflorum*.

Clave para las Especies Semejantes y/o que Comparten Distribución en México y América Central con *Combretum igneiflorum*

1a. Tallos espinosos; flores pentámeras; frutos con cinco alas ..... *C. decandrum*
1b. Tallos inermes; flores tetrámeras; frutos con cuatro alas.
2a. Inflorescencias en panículas o espigas no secundifloras; flores de menos de 1 cm de largo, de color blanquecino-amarillento, fragantes en fresco ..... *C. laxum*
2b. Inflorescencias en espigas secundifloras; flores de más de 1 cm, de color anaranjado-rojizo o amarillo, no fragantes en fresco.
3a. Pecíolo y nervaduras del envés de las hojas lepidotos.
4a. Pétalos y estambres amarillos; hojas cartáceas con indumento lepidoto de color amarillo-dorado a translúcido, nervación del envés reticulada ..... *C. fruticosum*
4b. Pétalos y estambres rojo-anaranjados; hojas papiráceas con indumento lepidoto de color translúcido a amarillo-dorado, nervación del envés no reticulada ..... *C. farinosum*
3b. Pecíolo y nervaduras del envés de las hojas por lo general lepidoto-pilosos.
5a. Frutos suborbiculares, rojos de hasta ca. 36 × 36 mm, con alas de más de 5 mm de ancho ..... *C. assimile*
5b. Frutos elípticos, de verde-amarillentos con tonos rojizos a pardos de hasta ca. 26 × 8 mm, con alas de menos de 4 mm de ancho ..... *C. igneiflorum*

Paratipos. MÉXICO. **Colima:** Manzanillo, 2 km al S del crucero Manzanillo-Cihuatlán, brecha a Peña Blanca, 19 sep. 1984, *F. J. Santana M. & N. Cervantes A. 642* (IBUG). **Jalisco:** Cabo Corrientes, camino que sale de la telesecundaria al Cerro El Vigía, por el camino a La Mina, al N de Villa del Mar, 20°12′N, 105°30′W, 27 nov. 1998, *R. Ramírez-Delgadillo & J. Espíndola 5712* (IBUG); cerro al NW de Villa del Mar, camino a La Mina, 20°14′07″N, 105°33′01″W, 11 nov. 1998, *R. Ramírez-Delgadillo & J. Espíndola 7301* (IBUG); La Huerta, a 9 km al NW de las oficinas de la Fundación Ecol. Cuixmala A. C., en el camino a El Mirador, 19°28′4″N, 104°58′16″W, 13 sep. 1997, *J. Calónico S., O. Téllez V. & A. Domínguez M. 4317* (MEXU); alrededor del Km 8.5 del camino viejo de terracería a Nacastillo, que inicia en el Km 63.5 (a un lado del puente Arroyo Chamela) de la Carr. Barra de Navidad-Puerto Vallarta, 19°31′47.2″N, 105°00′49.8″W, 10 oct. 1997, *J. Calónico S., O. Téllez V., A. Domínguez M. & J. Martínez C. 4086* (MEXU); Bosque de la Enseñanza, Est. Biol. IBUNAM, 11 oct. 2009, *F. J. Rendón-Sandoval, R. Ramírez-Delgadillo, A. Frías-Castro & E. Suárez-Muro 378* (IBUG); cerro al S del Estero Tenacatita, rumbo a los Ángeles Locos, UTM 515171 E, 2133204 N, 12 oct. 2009, *F. J. Rendón-Sandoval, R. Ramírez-Delgadillo, A. Frías-Castro & E. Suárez-Muro 383* (IBUG), 6 dic. 2009, *R. Ramírez-Delgadillo & A. Frías-Castro 7741* (IBUG); Isla San Agustín, Bahía de Chamela, *C. del Río 98* (MEXU); Isla San Pedro, Bahía de Chamela, *C. del Río 109* (MEXU); Km 11 del camino de terracería de las oficinas de la Fund. Ecol. Cuixmala A. C., hacia El Mirador, 19°28′45″N, 104°58′30″W, 13 sep. 1997, *J. Calónico S., O. Téllez V. & A. Domínguez M. 4247* (MEXU); Km 50–55 del lado costero de la Carr. México 200, entre Melaque y Chamela, UTM 494835 E, 2152421 N, 26 jul. 2009, *F. J. Rendón-Sandoval, R. Ramírez-Delgadillo, A. Castro-Castro & A. Frías-Castro 350* (IBUG).

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A New Species of *Solanum* (Solanaceae) from the Highlands of Central Brazil

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Abstract. A new species of *Solanum* L. belonging to subgenus *Leptostemonum* (Dunal) Bitter section *Acanthophora* Dunal (Solanaceae) is described and illustrated from the Distrito Federal in central Brazil. *Solanum savannarum* Ribeiro-Silva & Proença is a small, spindly herb or subshrub with spiny stems and petioles, weakly lobed leaves, pentamerous or tetramerous nodding white flowers with revolute sepals and petals, green attenuate anthers, pale green fruits mottled with dark green, each with ca. 11 seeds. The species is apparently endemic to highland savanna woodlands (cerrado) in the Brazilian states of the Distrito Federal, Goiás, and western Minas Gerais.

Resumo. Uma nova espécie de *Solanum* L., pertencente ao subgênero *Leptostemonum* (Dunal) Bitter seção *Acanthophora* Dunal (Solanaceae) é descrita e ilustrada. *Solanum savannarum* Ribeiro-Silva & Proença é uma pequena erva ou subarbusto com ramos e pecíolos aculeados, folhas fracamente lobadas, flores pentâmeras ou tetrâmeras, pêndulas, brancas, com sépalas e pétalas revolutas, anteras verdes, atenuadas, e frutos verde pálidos manchados de verde escuro com ca. 11 sementes. A espécie é aparentemente endêmica a cerrados de altitude do Distrito Federal, Goiás e oeste de Minas Gerais no Brasil Central.

Key words: Brazil, cerrado, IUCN Red List, savanna, section *Acanthophora*, *Solanum*, South America.

The cerrado biome, which covers ca. 2.4 million km² and 25% of Brazil's area, is the second largest biogeographic region in South America, after the Amazon rainforest. A species-rich, diverse savanna (Klink & Machado, 2005), the cerrado biome extends over virtually the entire states of Goiás, Tocantins, and the Distrito Federal, and extends into large areas of the states of Bahia, Ceará, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Piauí, Rondônia, and São Paulo (Ribeiro & Walter, 1998).

The genus *Solanum* L. (Solanaceae), with approximately 1400 species, is most diverse in South America, particularly in the Andes and on the Pacific coast (Hunziker, 2001). Based on morphological characters, seven *Solanum* subgenera are recognized in recent taxonomic classifications (D'Arcy, 1972, 1991), while chloroplast *ndhF* sequences have been used to identify 13 clades within the genus (Bohs, 2005; Weese & Bohs, 2007).

The present proposal is based on more than a decade of collecting, field observations, and study of herbarium material in the Distrito Federal and Goiás by the authors. The last collection made (*Proença et al. 3600* [UB]) was important to understand the distribution of the species. Our initial study, a floristic account of the genus *Solanum* in the Distrito Federal, Brazil, began in 1994. We recognized 22 species of *Solanum* in the Distrito Federal (Ribeiro-Silva, 1996), where the new species remained unidentified as *Solanum* sp. 2. Further study of the literature, and several additional collections, made it clear that *Solanum* sp. 2 is in fact a new species of subgenus *Leptostemonum* (Dunal) Bitter section *Acanthophora* Dunal, and is apparently restricted to woodland savanna vegetation in the Distrito Federal, Minas Gerais, and Goiás. Several specimens of this species are identified in NY as *S. foederale* M. Nee, a name that, as far as we are aware, has never been published. Given that this species is also relatively well-distributed in the Goiás highlands, as well as in the Distrito Federal and Minas Gerais, the epithet *foederale* no longer seems appropriate.

Solanum savannarum Ribeiro-Silva & Proença, sp. nov. TYPE: Brazil. Distrito Federal: Parque de Uso Múltiplo das Sucupiras, Setor Sudoeste,

15°47′S, 47°55″W, 960–1150 m, Nov. 2005, *F. B. Passos & C. Proença 77* (holotype, UB). Figure 1.

Haec species quoad aspectum pubescentiam habitumque *Solano tenuissimo* Sendt similis, sed ab eo antheris viridibus, fructu ovoideo majore atque seminibus pluribus (ca. 11) distinguitur.

Herb or subshrub, ca. 20–30 cm tall, armed; spines acicular, ca. 0.1–0.3 cm; stems terete, aculeate, with sparse to almost dense ferruginous indumentum composed of both glandular and non-glandular, 1-celled trichomes. *Lamina* 1.8–7.8 × 0.5–5 cm, solitary, concolorous, ovate-lanceolate, rough; apex acute to acuminate; base acute to rounded, sometimes asymmetrical; margin entire to slightly lobed; upper surface puberulous with simple, rarely stellate trichomes; lower surface with sparse, scabrid indumentum with rare glandular trichomes, these with the apical portion either 1-celled or multi-celled, the non-glandular trichomes many-celled, and many trichomes porrect-stellate, sessile or short-peduculate, with 2 to 4 radial cells and 1 short, central cell; midvein and laterals aculeate; petiole 0.2–1.1 cm, aculeate, with both glandular and non-glandular, 1-celled trichomes. *Cymes* umbelliform, extra-axillary, with ca. 5 flowers, peduncles ca. 0.3 cm, with non-glandular, 1-celled trichomes; pedicels 0.5–1.6 cm, with glandular, eglandular and stellate trichomes. Flowers with the calyx ca. 1 cm diam., externally with sparse glandular trichomes, non-glandular trichomes, and many stellate trichomes; calyx lobes ca. 0.4 cm, narrowly deltoid, persistent, and slightly accrescent in the fruit; corolla ca. 2 cm diam., all pentamerous or some flowers tetramerous, white with margins sometimes pale lilac, externally with 1-celled trichomes; corolla lobes ca. 1 cm, ovate-lanceolate; filaments ca. 0.2 cm, glabrous; anthers ca. 0.6 cm, green, attenuate, glabrous; ovary ca. 1 mm diam., ovoid, glabrous; style erect, ca. 8 mm, glabrous; stigma above the anthers. *Berry* ca. 1.5–2 cm diam., green-striate, ovoid to spheroid, glabrous, with ca. 11 seeds; peduncle in the fruit very short; *seeds* ca. 2 mm diam., light chestnut in color.

Distribution, ecology, and phenology. *Solanum savannarum* is distributed through highland areas of the Brazilian Shield, in Goiás, Minas Gerais, and the Distrito Federal, Brazil, ranging between ca. 14° and 18°S and between 48° and 53°W. Within this area, the taxon is probably restricted to areas above 1000 m. In the state of Goiás, *S. savannarum* is known from the Serra dos Cristais, Cristalina; Chapada dos Veadeiros, Alto Paraíso de Goiás; São João da Aliança; Serra de Catalão, Catalão; and Serra dos Caiapós, south of Caiapônia. In the Distrito Federal it occurs in several disturbed cerrado sites above 1000 m. There is some evidence that this species flowers after burning, which may be why it has persisted in disturbed cerrado areas in the Distrito Federal; these areas burn more frequently than well-preserved areas. Flowering was noted to occur from October to March and fruiting from November to April.

IUCN Red List category. According to IUCN Red List criteria (IUCN, 2001), *Solanum savannarum* should be regarded as Least Concern (LC). Nine populations are known across a relatively wide geographic range, within a habitat probably exceeding 20,000 km², although this habitat has suffered continuous reduction in size and quality (Klink & Machado, 2005).

Discussion. *Solanum savannarum* shows affinities with subgenus *Leptostemonum* (Dunal) Bitter, a group commonly known as the spiny solanums, due to their epidermal thorns, stellate trichomes, and attenuate anthers. *Solanum* subg. *Leptostemonum* is the second largest subgenus, with ca. 450 species (Whalen, 1984; Nee, 1999) with a worldwide distribution. The main center of diversity for this subgenus is within South America, followed by Australia and Africa (Whalen, 1984; D'Arcy, 1991; Symon, 1991). In Brazil this is the second most species-rich subgenus in *Solanum*, with approximately 110 species distributed across 10 sections. In the Distrito Federal, *Solanum* subg. *Leptostemonum* is the most species-rich with 16 species (Ribeiro-Silva, 1996) including this new taxon. Within subgenus *Leptostemonum*, the presence of simple trichomes on the upper leaf surface combined with stellate trichomes on the lower surface, and general appearance, would position *S. savannarum* within section *Acanthophora* Dunal, which is the largest section in Brazil, with ca. 22 species (Nee, 1991; Agra, 2007).

Solanum savannarum could be confused with *S. tenuissimum* Sendtn. due to its general aspect, pubescence, and habit. The latter species also occurs in central Brazil, in the state of Goiás, although the taxon was not found in the Distrito Federal, even after intensive collecting (Ribeiro-Silva et al., 1996). *Solanum tenuissimum*, however, can be distinguished by its yellow anthers, and the globose, smaller fruits (to ca. 0.4 cm in diameter) with at most three seeds per fruit; *S. savannarum* is distinguishable by its green anthers and the ovoid, larger fruits that present more seeds per fruit (ca. 11).

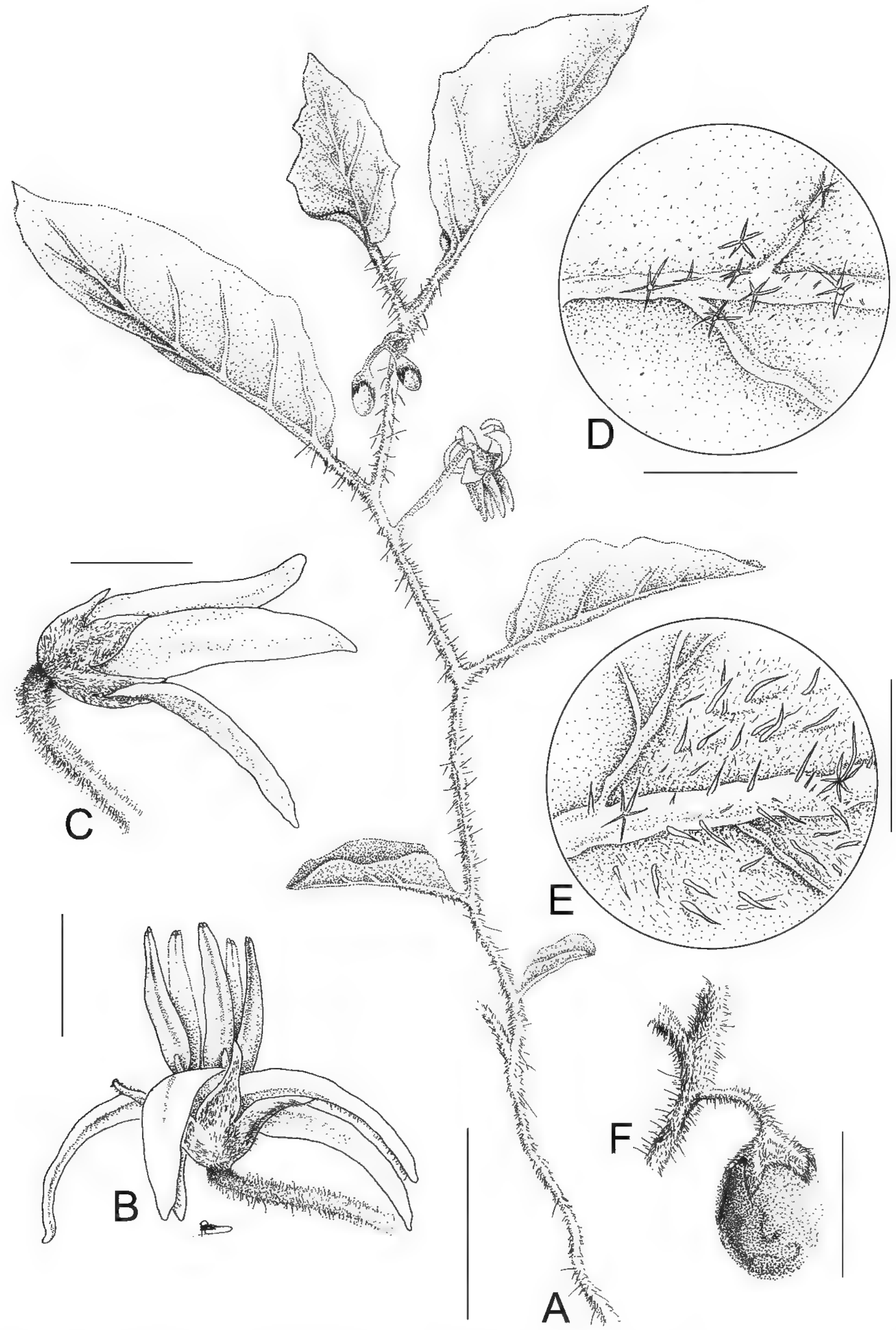

Figure 1. *Solanum savannarum* Ribeiro-Silva & Proença. —A. Habit. —B. Open flower showing attenuate anthers. —C. Closed flower. —D. Detail of lower leaf surface. —E. Detail of upper leaf surface. —F. Fruit. Scales: A — 5 cm; B, C — 5 mm; D, E — 0.15 mm; F — 2 cm.

Paratypes. BRAZIL. **Distrito Federal:** Barragem do Rio São Bartolomeu, Nov. 1973, *E. P. Heringer 12995* (NY, UB); betw. Brasília & Sobradinho, Oct. 1965, *H. S. Irwin, R. Souza & R. Reis dos Santos 9169* (NY); Brasília, *H. S. Irwin et al. 10273* (NY); estrada para Planaltina, ca. 25 km W of Brasília, Oct. 1965, *H. S. Irwin R. Souza & R. Reis dos Santos 9521* (NY, UB); Gama, Nov. 1976, *A. Allem 331* (CEN); Horto do Guará, Jan. 1961, *E. P. Heringer 7852*

(UB); s. loc., Mar. 1959, *E. P. Heringer 6705* (UB); Jardim Botânico de Brasília, Oct. 1986, *C. Proença 650* (HEPH); campo após a área de lazer 31 Jan. 2008, *R. G. Chacon, R. Correa & A. G. Amaral 260* (HEPH); Reserva Ecológica do IBGE, Nov. 1983, *B. A. S. Pereira 873* (IBGE, NY), cerrado nearby greenhouse, Feb. 1995, *S. R. Silva 52* (NY, UB), Jan. 1981, *F. C. Silva 428* (IBGE); Sede do IBDF, Apr. 1976, *E. P. Heringer 15519* (UB), Córrego Taquara, Oct. 1999, *M. Fonseca & D. Alvarenga 2192* (IBGE, NY, UB). **Goiás:** São João da Aliança, 3 km NE of São João da Aliança, Mar. 1973, *W. R. Anderson et al. 7730* (NY, UB); Cristalina, Nov. 2008, *C. Proença, F. B. Passos & R. G. Chacon 3600* (UB); Chapada dos Veadeiros, Feb. 1966, *H. S. Irwin et al. 12844* (NY); ca. 58 km NE de Catalão, 26 Jan. 1970, *H. S. Irwin et al. 25451* (NY); Serra do Caiapó, ca. 60 km S of Caiapônia, rd. to Jataí, Nov. 1964, *H. S. Irwin & T. R. Soderstrom 7565* (NY). **Minas Gerais:** Serra do Rio Preto, ca. 5 km E of Goiás, rd. to Guarapuava, Nov. 1965, *H. S. Irwin, R. Souza & R. Reis dos Santos 10279* (NY).

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A New Species of *Iochroma* (Solanaceae) from Ecuador

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Abstract. *Iochroma baumii* S. D. Sm. & S. Leiva (Solanaceae) is described from the cloud forests of Napo in northern Ecuador. We provide a summary of the phylogenetic relationships and recent taxonomic changes in *Iochroma* Benth. and related genera and discuss the phylogenetic placement of this newest species. *Iochroma baumii* shares its geographic distribution and many floral features with its closest relatives *I. calycinum* Benth., *I. fuchsioides* (Bonpl.) Miers, and *I. gesnerioides* (Kunth) Miers, but its deep blue flowers with involute corolla lobes, which appear in clusters along older branches, make it easily distinguishable from its congeners.

Resumen. Se describe *Iochroma baumii* S. D. Sm. & S. Leiva (Solanaceae) de los bosques nublados del norte de Ecuador. Presentamos un resumen de las relaciones filogenéticas y cambios taxonómicos más recientes en *Iochroma* Benth. y los géneros afines. También discutimos la relaciones filogenéticas entre esta nueva especie y las otras especies de *Iochroma*. *Iochroma baumii* comparte su distribución geográfica y características florales con las especies hermanas: *I. calycinum* Benth., *I. fuchsioides* (Bonpl.) Miers y *I. gesnerioides* (Kunth) Miers, pero, por sus flores azúl-oscuro con lóbulos involutos, que aparecen agrupadas en ramas maduras, se distingue fácilmente de las otras especies de *Iochroma*.

Key words: Andean, Ecuador, *Iochroma*, Iochrominae, IUCN Red List, Solanaceae.

Iochroma Benth. (Solanaceae) is a genus of around 25 species of unarmed shrubs and treelets distributed from Colombia to Peru (Shaw, 1998; Hunziker, 2001; Smith & Baum, 2006, Leiva, 2009). A member of Physaleae Miers (Olmstead et al., 2008), the genus is perhaps best known for its colorful, tubular flowers, and some species are cultivated as ornamentals (Shaw, 1998). *Iochroma* species are most common in cloud forest gaps and disturbed areas between 1800 and 2800 m, and their flowers are pollinated by hummingbirds and a range of insects (Smith et al., 2008).

Recent phylogenetic work has clarified relationships between *Iochroma* and the allied genera *Acnistus* Schott, *Dunalia* Kunth, *Eriolarynx* (Hunz.) Hunz., *Saracha* Ruiz & Pav., and *Vassobia* Rusby, which together comprise Iochrominae sensu Olmstead et al. (1999, 2008). Most of the species of *Iochroma* fall into a core clade with four subclades, designated with the letters A, C, L, and F (Smith & Baum, 2006; Table 1). There is an additional small clade of five *Iochroma* species (the U clade) that appears closely related to core clade in some gene trees and more distant in others (Smith & Baum, 2006). Finally, three species traditionally placed in *Iochroma* are actually more closely related to species in other genera, e.g., *Dunalia*, *Eriolarynx*, and *Datura* L. (Smith & Baum, 2006; Olmstead et al., 2008; Table 1).

Despite these advances in understanding phylogenetic relationships, much remains to be discovered about the ecology, biogeography, and evolutionary history of *Iochroma*. The most recent treatment of *Iochroma* included only 15 species (Shaw, 1998), but 12 new species have been described since 1995 (Leiva, 1995, 2005, 2006, 2007, 2009; Leiva et al., 1998; Leiva & Quipuscoa, 1998; Lezama et al., 2007). Many of these are known exclusively from a single collection or a single locality, and several have not been included in phylogenetic analysis (Table 1). Some of these new taxa are known to be products of interspecific hybridization (Smith & Baum, 2006; Smith et al., 2008; Table 1) as interspecific crossability is widespread in the Iochrominae (Smith & Baum, 2007). Still, the extent of contact and hybridization among *Iochroma* species in nature is largely unknown. In addition to the taxa listed in

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Table 1. Species of *Iochroma* and their phylogenetic placement. In addition to the species included in the most recent treatment (Shaw, 1998), we list the 12 species recently described from Peru by S. Leiva. Clade letters refer to the phylogenetic placement in Smith and Baum (2006), with an asterisk after the clade denoting placement predicted from morphology. Known or suspected hybrids were not placed in clades nor were taxa excluded, based on the phylogeny (Smith & Baum, 2006). The C, L, F, and U clades contain only species traditionally placed in *Iochroma*, whereas the A clade also contains the monotypic genus *Acnistus* Schott. Country abbreviations are as follows: Argentina (ARG), Bolivia (BOL), Colombia (COL), Ecuador (ECU), Peru (PER); SDS and SLG refer to the author initials.

Clade	Species	Distribution	Notes
A	*I. confertiflorum* (Miers) Hunz.	ECU, PER	
A	*I. edule* S. Leiva	PER	
A	*I. ellipticum* (Hook. f.) Hunz.	ECU	
A	*I. peruvianum* (Dunal) J. F. Macbr.	PER	
A	*I. salpoanum* S. Leiva & Lezama	PER	
A*	*I. smithianum* K. Lezama, Limo & S. Leiva	PER	known only from type collection
A*	*I. tupayachianum* S. Leiva	PER	
C*	*I. albianthum* S. Leiva	PER	known only from type collection
C	*I. cyaneum* (Lindl.) M. L. Green	ECU, PER	
C	*I. cornifolium* (Kunth) Miers	COL,[4] ECU, PER	
C	*I. loxense* (Kunth) Miers	ECU, PER (?)	
C*	*I. schellerupii* S. Leiva	PER	affined to *I. cornifolium* by SDS
L	*I. lehmannii* Bitter	ECU, PER	
L	*I. squamosum* S. Leiva & Quipuscoa	PER	affined to *I. lehmannii* by SDS
F	*I. baumii* S. D. Sm. & S. Leiva	ECU	
F	*I. calycinum* Benth.	ECU, PER[4]	
F	*I. fuchsioides* Miers	COL, ECU	
F	*I. gesnerioides* (Kunth) Miers	COL, ECU	
U	*I. grandiflorum* Benth.	ECU, PER	
U*	*I. lilacinum* S. Leiva & K. Lezama	PER	known only from type locality
U	*I. nitidum* S. Leiva & Quipuscoa	PER	
U	*I. tingoanum* S. Leiva	PER	
U	*I. umbellatum* (Ruíz & Pav.) Hunz. ex D'Arcy	PER	
Hybrid	*I. ayabacense* S. Leiva	PER	known only from type locality; homoploid hybrid between *I. lehmannii* (*I. squamosum*) and *I. cyaneum*[2]
Hybrid*	*I. piuranum* S. Leiva	PER	known only from type locality
Hybrid	*I. stenanthum* S. Leiva, Quipuscoa & N. W. Sawyer	PER	known only from type locality; possible hybrid between *I. cornifolium* and *A. arborescens* (L.) Schltdl. or other member of A clade[1]
Hybrid	*Iochroma* sp. indet., ?	PER	possible hybrid between *A. arborescens* or a member of U clade[1]
Excluded	*I. parvifolium* (Roem. & Schult.) D'Arcy	PER	more closely related to *Dunalia* Kunth. species than to *Iochroma* Benth[1]
Excluded	*I. cardenasianum* Hunz.	BOL	distantly related to other *Iochroma* species[1]; belongs to Datureae[3]
Excluded	*I. australe* Griseb.	ARG, BOL	more closely related to *Eriolarynx* (Hunz.) Hunz. species than to *Iochroma*[1]

[1] Smith & Baum, 2006.
[2] Smith et al., 2008.
[3] Olmstead et al., 2008.
[4] Shaw, 1998; specimens of these species from these countries have not been seen by the authors.

Table 1, several collections cannot be confidently assigned to a currently described species and may represent additional taxa deserving of species recognition (S. Leiva, pers. obs.).

Here we describe a new species of *Iochroma* from the cloud forests near Papallacta in northern Ecuador. Phylogenetic analysis places this taxon in the northern Andean F clade, which contains two red-flowered species (*I. gesnerioides* (Kunth) Miers and *I. fuchsioides* (Bonpl.) Miers) and another blue-flowered species, *I. calycinum* Benth. The new species shares with *I. calycinum* deeply pigmented flowers, which

are variously described as purple, violet, and blue. Like other members of the F clade as well as the C clade, *I. baumii* S. D. Sm. & S. Leiva corollas have 10 teeth, sensu Shaw (1998), with five large teeth corresponding to the larger lobes and five smaller teeth alternate to the lobes. Also, similar to *I. gesnerioides* and *I. calycinum*, *I. baumii* produces masses of flowers in clusters along older branches, resulting in showy displays of hundreds of flowers in peak season. Its phylogenetic placement as one of the closest blue-flowered relatives to the two red-flowered *Iochroma* species will make continued study of *I. baumii* crucial to understanding the selective and genetic mechanisms underlying the evolutionary transition from blue to red pigmentation.

Iochroma baumii S. D. Sm. & S. Leiva, sp. nov. TYPE: Ecuador. Napo: near Papallacta, 00°22.076′S, 78°6.283′W, cloud forest, 2811 m, 4 Jan. 2005, *S. D. Smith 476 with L. Lopez* (holotype, MO accession #5448818; isotypes, F, MO accession #5875462, QCNE, WIS). Figure 1.

Haec species quoad corollam cyaneo-violaceam limbo 10-lobo lobis 5 majoribus cum 5 minoribus alternantibus *Iochromate calycino* Benth. affinis, sed ab eo inflorescentiis secus ramos vetustos aphyllos productis atque calyce tubuloso usque breviter urceolato viridi-cyaneo pubescente sub anthesi 4–9 mm longo et 3.8–6 mm crasso differt.

Treelet, (1.5–)2–4 m tall, with leaves clustered toward tip of branches and absent in mature growth; young stems, green, sometimes tinged with purple, pubescent with branched hairs, older stems glabrescent. Leaves (6–)9–17 × (2.5–)3–6 cm, alternate, entire, elliptic to lanceolate, adaxial surface with branched hairs, abaxial surface densely covered in branched hairs; base cuneate; apex acuminate; petioles (0.8–)1.2–2.3 cm. Inflorescences axillary, typically on older, often leafless branches, rarely near the shoot apex, 6- to 12-flowered; pedicels 0.7–1.4 cm in flower, 1.5–2.5 cm in fruit, terete, pendulous, with few to many branched hairs. Calyx tubular to slightly urceolate, purplish green, with few to many branched hairs, 4–9 × 3.8–6 mm in flower, 9–12 × 10–15 mm in fruit, with 5 broadly triangular lobes, sometimes with 2 fused to give the appearance of 4 lobes, shallowly divided in flower, becoming more deeply divided in fruit; corolla, tubular, flaring at the mouth, exterior deep blue-purple, with few to many simple or occasionally branched hairs, increasing toward the mouth, interior white with purple at the mouth, glabrous or with a few glandular hairs near the base, 28–45 × 4–6 mm at anthesis, 10-lobed, with 5 major lobes, acute in the apex and involute forming a small hood, alternating with 5 minor lobes; stamens 5, included; filaments white or lilac, with simple and branched hairs, to 0.5 mm, on the basal 2/3, fused to the corolla on the bottom half (1–1.8 cm) with the free portion 1.3–2.4 cm; anthers 4–5.2 × 1–1.5 mm, oblong, purple, longitudinally-dehiscent; ovary 3.3–4.8 × 2–2.8 mm, pyriform, glabrous, with orange-yellow nectariferous disk, style 2.7–3.5 cm, stigma green, clavate, bilobed. Berry 1.2–1.7 × 1–1.5 cm, green or green and purple at maturity with few to many sclerosomes, slightly conical, bottom 2/3 enveloped in accrescent fruiting calyx, style persistent (in fresh material); seeds 70 to 200 per fruit, 1–1.5 mm × 1.4–1.7 mm, yellow, reniform.

Etymology. This species is dedicated to David A. Baum (1964–), professor of botany at the University of Wisconsin–Madison, in recognition of his contributions to understanding of the nature of species and his efforts to promote the incorporation of phylogenetics and tree-thinking in education at all levels.

Distribution and ecology. Iochroma baumii is endemic to the Andes of northern Ecuador and possibly Colombia. Its presence in Colombia is based on a single specimen collected in Caldas in 1946 (*J. Cuatrecasas 23329*, F); additional collecting effort will be necessary to determine if *I. baumii* persists there and in other parts of the country. *Iochroma baumii* shares its northern Andean distribution with other members of the F clade, but it is not known to occur in sympatry with any of these. In the type locality, *I. baumii* occurs in disturbed cloud forest habitats, such as pasture hedges, forest gaps, and roadsides. Population sizes appear small with individuals sparsely distributed, typically occurring no closer than 200 m apart. From the known collections, peak flowering occurs from December to May. Its flowers are unscented and appear protogynous like most *Iochroma* species (Smith et al., 2008). Despite its abundant displays, no pollinators have been observed during collecting trips. The related taxa (blue-flowered *I. calycinum* and red-flowered *I. fuchsioides* and *I. gesnerioides*) are principally pollinated by hummingbirds (Smith et al., 2008), but additional observations will be required to determine if *I. baumii* shares this pollination system.

IUCN Red List category. We currently categorized the conservation status of this taxon as DD (Data Deficient; IUCN, 2001). We have not to date conducted extensive surveys of the area where most of the collections have been made (the Napo Province of Peru), and thus the size of the populations is not well known. Also, the first authors have not collected

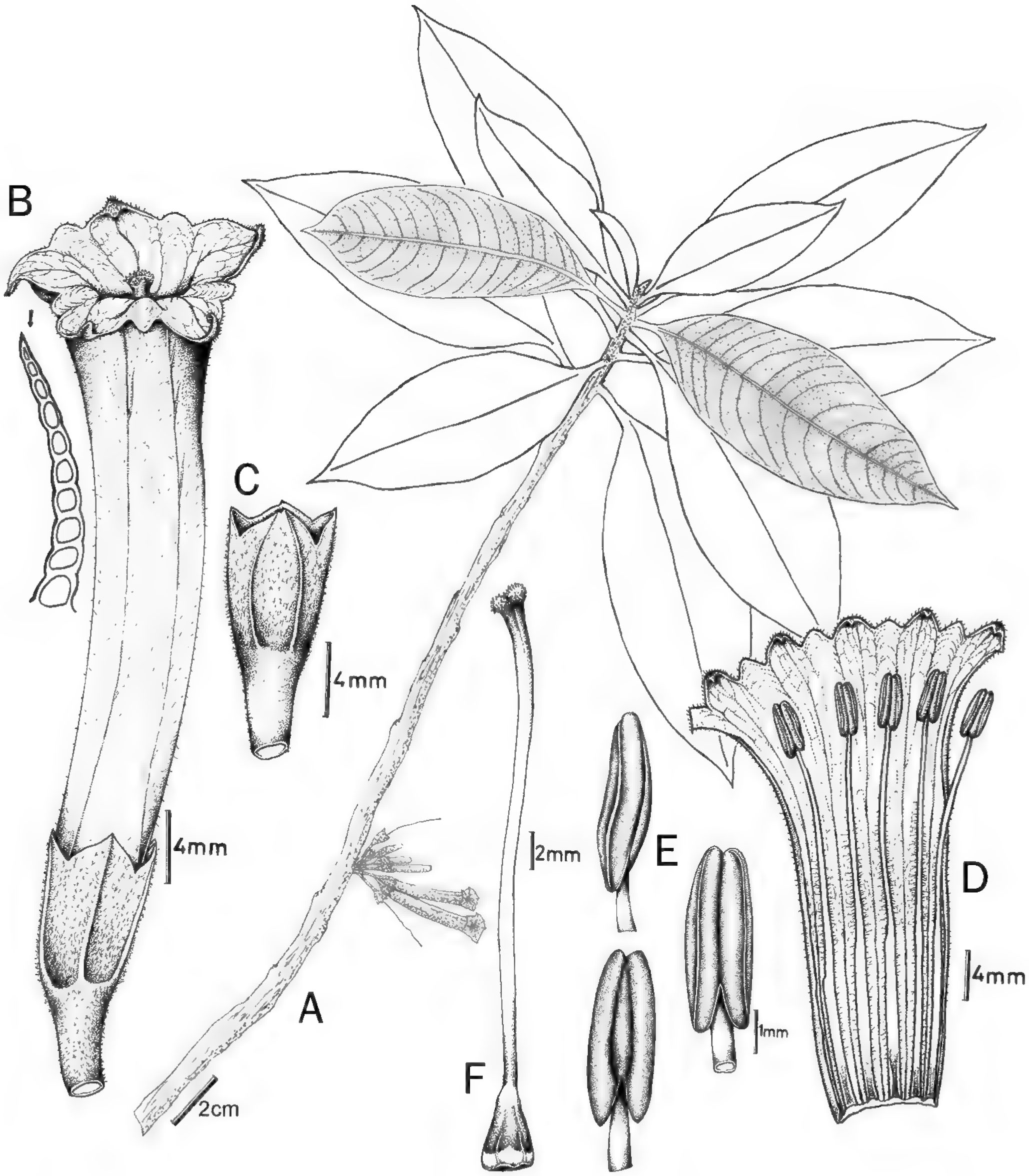

Figure 1. *Iochroma baumii* S. D. Sm. & S. Leiva. —A. Flowering branch. Leaf on the left shows the abaxial surface and on the right the adaxial surface. —B. Flower. Detail is shown for the simple hairs found on the corolla. —C. Calyx. —D. Inner corolla surface, showing the stamens. —E. Detail for the anthers, showing (clockwise from top) lateral view, adaxial view, and abaxial view. —F. Gynoecium. Drawn from *S. D. Smith 477 with L. Lopez* (MO) by S. D. Smith (A) and S. Leiva (B–F).

the species in Colombia, which may harbor additional populations.

Relationships. Within the well-supported F clade (Smith & Baum, 2006), the exact relationship of *Iochroma baumii* to *I. calycinum*, *I. fuchsioides*, and *I. gesnerioides* remains uncertain. The combined 3-gene analysis places it (identified as *Iochroma* sp. nov.) sister to the other blue species, *I. calycinum*, with moderate levels of support; however, the three individual gene trees each show different relationships for these four taxa (Smith & Baum, 2006). Such a pattern may be expected if the lineages diverged in a short amount of time with differences in lineage sorting among genes. Phylogenetic analysis of additional individuals and genes will be required to identify the dominant phylogenetic pattern and the sources of discordance among gene trees.

Although the exact phylogenetic placement of *Iochroma baumii* is still unclear, the species is easily distinguished from other *Iochroma* species by several morphological features. First, two of the other blue species (*I. calycinum* and *I. cornifolium* (Kunth) Miers) have large inflated calyces in flower while *I. baumii* does not. It is also easily distinguished from the blue members of the U clade (e.g., *I. nitidum* S. Leiva & Quipuscoa and *I. grandiflorum* Benth.) that possess salverform corollas with five triangular corolla lobes compared to the tubular corollas with 10 teeth in *I. baumii*. The species is perhaps most readily confused with *I. cyaneum* (Lindl.) M. L. Green. The distribution of *I. cyaneum* is centered in southern Ecuador, but it is occasionally found in the north, possibly due to its cultivation as an ornamental. The two species can be distinguished by the fact that *I. cyaneum* retains leaves on older branches and most inflorescences are found near the shoot apex (as opposed to being on older branches in *I. baumii*). Also, *I. baumii* flowers have a distinctive hood on the major corolla lobes (Fig. 1), and its inflorescences have fewer flowers (six to 12 vs. 10 to 40 in *I. cyaneum*).

For specimens in which the flower color has faded or is not noted, there are several features that can be used to distinguish the deep blue flowers of *Iochroma baumii* from the red-flowered *I. gesnerioides* and *I. fuchsioides*. The calyx of *I. gesnerioides* is typically smaller, 3–5 mm, and *I. gesnerioides* often has larger numbers of flowers (10 to 25) per inflorescence, up to 120 according to Shaw (1998). *Iochroma fuchsioides* is largely glabrous, with at most a few simple hairs on flowers and vegetative tissue. For both red-flowered species, the flowers lack the hood on the major corolla lobes, and the anthers are often exserted in mature flowers while they are consistently included in *I. baumii*.

Paratypes. COLOMBIA. **Caldas:** Hoya del rio Otún, Peña Bonita, *J. Cuatrecasas 23329* (F). ECUADOR. **Napo:** El Chaco Canton, Rio Oyacachi, Sector Nono, path betw. Oyacachi & El Chaco, 00°13′S, 78°02′W, *J. L. Clark 3587 with J. Letham, D. Parion & M. Thurber* (MO, QCNE); carr. Quito Baeza Cosanga Napo, colecciones entre Baeza y Cosanga, *A. Freire F. et al. 926* (F, QCA); Rd. Baeza Papallacta, a few km. E of Papallacta, *C. Padilla 1448* (MO, QCNE, WIS); Rd. Baeza Papallacta, 00°22.780′S, 78°7.687′W, *S. D. Smith with L. Lopez 477* (F, MO, QCNE, WIS).

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Rubiacearum Americanarum Magna Hama Pars XXIX: Overview of the Neotropical Genus *Schizocalyx* (Condamineeae) and Description of Two New Species

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Abstract. The genus *Schizocalyx* Wedd. was originally monotypic, but has been recently expanded based on molecular analysis to comprise six species, including four transferred from *Bathysa* C. Presl, where they were incorrectly classified, and two transferred from *Phitopis* Hook. f., which is now a synonym. *Schizocalyx* is now characterized by its calyptrate stipules, corollas with the lobes convolute in bud, capsules that are loculicidal across the apical part, and numerous flattened to angled seeds, as detailed in a revised genus description. This genus is now known from southern Central America through western South America and into central and southeastern Brazil. The nine species keyed here include the seven species previously described, for which nomenclature and range are summarized, and two species newly described here: *S. condoricus* D. A. Neill & C. M. Taylor, found in the eastern Andean foothills of southern Ecuador and previously confused with *S. peruvianus* (K. Krause) Kainul. & B. Bremer; and *Schizocalyx truncatus* C. M. Taylor, found in the eastern Andean foothills of central Peru and previously confused with *S. obovatus* (K. Schum. ex Standl.) Kainul. & B. Bremer. Lectotypes are selected for *S. cuspidatus* (A. St.-Hil.) Kainul. & B. Bremer and *S. multiflorus* (Hook. f.) Kainul. & B. Bremer.

Resumen. El género *Schizocalyx* Wedd. originalmente fue monotípico, pero ha sido ampliado recientemente para incluir seis especies, incluyendo cuatro especies transferidas de *Bathysa* C. Presl, en lo cual estaban clasificadas erróneamente, y dos especies transferidas de *Phitopis* Hook. f., lo cual es actualmente un sinónimo. *Schizocalyx* actualmente se caracteriza por las estípulas caliptradas, corolas con los lóbulos convolutos en la yema, cápsulas loculicidales en la parte apical y semillas numerosas, aplanadas o anguladas, como se detalle en una descripción genérica actualizada. El género actualmente está registrada desde el sur de América Central a través de Sudamérica occidental hasta Brasil central y suroriental. Las nueve especies indicadas en este sinopsis con claves incluyen las siete especies descritas anteriormente para las cuales se indica su nomenclatura y su rango de distribución, y dos especies nuevas descritas en este artículo: *S. condoricus* D. A. Neill & C. M. Taylor se encuentra en las cordilleras al este de los Andes en el sur del Ecuador, y previamente ha sido confundida con *S. peruvianus* (K. Krause) Kainul. & B. Bremer; y *S. truncatus* C. M. Taylor se encuentra en las cordilleras al este de los Andes en el centro de Perú y ha sido confundida con *S. obovatus* (K. Schum. ex Standl.) Kainul. & B. Bremer. Lectotipos son seleccionados para *S. cuspidatus* (A. St.-Hil.) Kainul. & B. Bremer and *S. multiflorus* (Hook. f.) Kainul. & B. Bremer.

Key words: *Bathysa*, Bolivia, Brazil, Colombia, Condamineeae, Costa Rica, Ecuador, IUCN Red List, Neotropics, Panama, Peru, *Phitopis*, Rondeletieae, Rubiaceae, *Schizocalyx*.

The genus *Schizocalyx* Wedd. (Weddell, 1854) was described with a single species from Colombia, *S. bracteosus* Wedd., which is a tree with terminal cymose inflorescences, bisexual flowers with calycophylls, tubular corollas with five lobes that are convolute (Lawrance, 1951; i.e., cortorted sensu Stearn, 1983) in bud, and small capsules that are loculicidal across the apical part with numerous small, angled seeds. *Schizocalyx* was included in the tribe Cinchoneae by Schumann (1891), in a subgroup of genera of this tribe with convolute corolla aestivation. *Schizocalyx* was included in the Cincho-

neae also by Robbrecht (1988), but shortly afterward the genera that had been included there were found to comprise a heterogeneous assemblage and several were transferred to other tribes. Based on analysis of morphological characters, Andersson and Persson (1991) transferred *Schizocalyx* to their newly described tribe Calycophylleae. However, after further study of its pollen (Andersson, 1993), seeds, and fruits, Andersson (1995) excluded *Schizocalyx* from the Calycophylleae and considered it to be related instead to *Bathysa* C. Presl, which was then classified in the Rondeletieae (Robbrecht, 1988). Delprete (1997) noted Andersson's observations and synonymized *Schizocalyx* with *Bathysa*, and included *Bathysa* in his revised circumscription of Rondeletieae (Delprete, 1999). Later Rova et al. (2002) studied the various genera that have been included in the Rondeletieae. They used molecular sequence data and included in their analysis two species of *Bathysa*, *B. veraguensis* Dwyer and another species identified only as "*Bathysa* sp."; this second sample is vouchered by the specimen *B. Ståhl 3272* at GB, for which a species-level identification is still not available. They found the two *Bathysa* species grouped with several other genera that had been variously included in Calycophylleae and Rondeletieae, and their results showed that all of these genera could not be included in Rondeletieae. Subsequently, *Bathysa* and *Schizocalyx* were included in an analysis of the relationships of several systematically problematic Rubiaceae genera by Kainulainen et al. (2010), using both molecular and morphological characters and a more detailed taxon sampling. They found *Schizocalyx* to be distinct from *Bathysa*, and their results showed that these genera are not particularly closely related. Kainulainen et al. included both *Schizocalyx* and *Bathysa* in their newly circumscribed Condamineeae; identified some morphological characters that distinguish these two genera; and transferred several species from *Bathysa* to *Schizocalyx*.

Schizocalyx bracteosus is very similar in general aspect and many of its characters to several species that have been included in *Bathysa*, including species that remain in *Bathysa* in Kainulainen et al.'s classification (2010). These two genera were originally distinguished in part by their corolla aestivation, with the lobes imbricate in bud in *Bathysa* (Standley, 1931a: 259) versus convolute in *Schizocalyx* (Standley, 1930: 171); however, this character was overlooked by several authors including Delprete (1997), who incorrectly described the corolla aestivation of *S. bracteosus* as imbricate. Perhaps the first example of this confusion is by Krause (1908), who described *B. peruviana* K. Krause in *Bathysa* even though its corolla lobes are convolute in bud on his type specimen, and who did not mention the discrepancy between this feature and the morphological characteristics of *Bathysa*. The confusion between these two genera was continued by Standley (1931a, 1936), who described and keyed *B. obovata* K. Schum. ex. Standl. as having the corolla lobes imbricate in bud even though the flowers of his type specimen have convolute lobes, and who also did not mention this discrepancy nor emend the description of *Bathysa* to include convolute corollas. The confusion was continued by Dwyer (1980) and Burger and Taylor (1993), who incorrectly described the convolute corolla aestivation of *B. veraguensis* as imbricate. Corolla aestivation is most often consistent within genera of Rubiaceae, and is one of the characters that distinguishes *Schizocalyx* from *Bathysa*; these are also separated by their stipule form, which is calyptrate (i.e., fused into a conical sheath) in *Schizocalyx* versus interpetiolar in *Bathysa*, and their fruit dehiscence, with the capsules splitting septicidally for more than half their length in *Bathysa* versus loculicidally across only the apical part of the capsule in *Schizocalyx* (Kainulainen et al., 2010). This difference in fruit dehiscence has also been sometimes overlooked (e.g., Delprete, 1997).

The genus *Phitopis* Hook. f. was described (Hooker, 1871) with one species from Peru, *P. multiflora* Hook. f., a tree with caducous stipules of unknown form, terminal cymose inflorescences, bisexual flowers, funnelform corollas with five convolute lobes, and capsular fruits with loculicidal dehiscence across their tops and numerous small, angled seeds. A second species was described 60 years later, *P. sterculioides* Standl. of Peru (Standley, 1931b), and apparently the only floristic treatment of *Phitopis* was provided by Standley (1936). The name *Phitopis* is an anagram of *Hippotis* Ruiz & Pav. and referred to the similar general aspects of these two genera, in particular their hirsute pubescence and irregularly lobed calyx limbs. However, these genera are not closely related, and Rova and Andersson (1995) excluded *Phitopis* from the tribe Hippotideae. Schumann (1891) placed *Phitopis* in his tribe Rondeletieae together with *Bathysa*, as did Standley (1936); however, the genera Schumann placed in that tribe are today considered to be a heterogeneous group and are classified in several different tribes (Robbrecht, 1988; Rova et al., 2002; Kainulainen et al., 2010). *Phitopis* was considered too poorly known and not classified to tribe at all by some recent workers (e.g., Robbrecht, 1988), but Delprete (1999) included *Phitopis* in his circumscription of Rondele-

tieae, where he considered it closely related to *Bathysa*. Subsequently, Kainulainen et al. (2010) demonstrated that *Phitopis* is not closely related to *Bathysa*; however, *Schizocalyx* and *Phitopis* are not distinguished by any morphological or molecular sequence characters, and they synonymized *Phitopis* with *Schizocalyx*.

Schizocalyx Today

Schizocalyx now includes nine species, including the two newly described here, and is characterized by the combination of its stipules that are calyptrate (i.e., fused into a sheathing cap), caducous, and often well-developed; its subsessile to petiolate leaves that are opposite, ternate, or quaternate in arrangement; its terminal, bracteate, cymose inflorescences that are branched to several orders; its small- to medium-sized flowers; its open and regularly lobed or calyptrate and irregularly lobed calyx limbs that rarely bear petaloid calycophylls; its white corollas with rather stout tubes and the five lobes convolute in bud; its five stamens and two linear stigmas that are all exserted from the corolla; its dry capsular fruits that open loculicidally via a slit across the top, inside the persistent calyx limb; and its numerous small, angled seeds. *Schizocalyx* is found in lowland to premontane wet forests in southern Central America and western South America from Colombia to Bolivia, and into central southeastern Brazil and there sometimes in moist forest or gallery forest. The flowers are reported to be fragrant and are protandrous, with the anthers on herbarium specimens apparently falling off completely before the two stigmas spread to expose their receptive surfaces.

The calyx form varies notably among species of *Schizocalyx*. Several species have the calyx limb similar in form to that of most species of Rubiaceae: tubular, apparently open in bud, and truncate to regularly denticulate or shortly lobed (e.g., *S. obovatus* (K. Schum. ex Standl.) Kainul. & B. Bremer). *Schizocalyx bracteosus* has tubular to reduced calyx limbs and is so far unique in the genus in the petaloid calycophylls that are found on one or more of the flowers in each inflorescence. In other species the calyx tube is rather unusual: it is extended and inflated into a conical structure that is regularly to irregularly lobed and only very narrowly open at the top in bud (e.g., *S. peruvianus*), or in some species the calyx is calyptrate (i.e., fully fused) and completely encloses the corolla in bud, splitting irregularly as the corolla emerges (e.g., *S. stercu-lioides*). Other genera of Rubiaceae include species both with and without petaloid calycophylls (Delprete, 1996) and with both regularly lobed and calyptrate calyx limbs (e.g., *Pentagonia* Benth., Rova & Andersson, 1995; *Palicourea* Aubl., Taylor, 1989) and stipules (e.g., *Psychotria* L. subg. *Psychotria*, Taylor et al., 2004; *Ladenbergia* Klotzsch, Andersson, 1997). Thus the variation in stipule and calyx form among closely related species of *Schizocalyx* is not exceptional in Rubiaceae. The calyx limb of some *Schizocalyx* species often continues to elongate and change its form as the fruits mature, in particular splitting irregularly as the capsule enlarges, and interpretation of its morphology can be confounded by these changes.

Bathysa Today

The morphological features cited for *Bathysa* (Germano Filho, 1998; Taylor et al., 2004) have not been emended: this genus is characterized by interpetiolar or calyptrate, caducous or persistent, often well-developed stipules; subsessile to petiolate, opposite or ternate leaves; terminal, bracteate, cymose to thyrsiform inflorescences that are usually branched to several orders; small- to medium-sized protandrous flowers; tubular, truncate to denticulate or lobed calyx limbs that apparently lack petaloid calycophylls; white to pale green, funnelform to campanulate corollas with the tube pubescent inside at the stamen attachment and the four or five lobes thinly imbricate in bud; the stamens and linear stigmas all exserted from the corolla, with the filaments inserted in the upper part of the corolla tube and pubescent in their lower portion; dry capsular fruits that are septicidal and split for half or more of their length; and numerous, small, angled seeds. *Bathysa* is now known only from South America, where it is found in lowland to premontane vegetation from Venezuela to southeastern Brazil and the Andes of Peru and Bolivia. All of the species transferred from *Bathysa* to *Schizocalyx* by Kainulainen et al. (2010) were inaccurately classified in *Bathysa*.

Kainulainen et al. (2010) noted that two *Bathysa* species were not included in their molecular analysis and are of uncertain classification, *B. bathysoides* (Steyerm.) Delprete, found from Venezuela to eastern Peru and northern Bolivia, and *B. perijaensis* (Steyerm.) Delprete of northwestern Venezuela, which is closely similar to *B. bathysoides* if not conspecific. These species both have calyptrate stipules, regularly and deeply 5-lobed calyx limbs with the lobes open in bud, corollas with five imbricate lobes, stamens inserted in the corolla throat, and capsules that split septicidally for more than half their length. Thus, these species agree with the features of *Bathysa*

except perhaps in their calyptrate stipules, which are not otherwise now known in that genus.

Another species that was included in *Bathysa*, *B. panamensis* Dwyer, was also incorrectly classified and has been transferred to *Simira* Aubl., as *S. panamensis* (Dwyer) C. M. Taylor (Taylor et al., 2011). The name *B. multiflora* L. O. Williams was based on a type specimen from Peru, but was overlooked in the catalogue of Peruvian Rubiaceae (Taylor & Pool, 1993): this name is a synonym of *B. australis* (A. St.-Hil.) Hook. f. ex K. Schum.

Methods

The calyx limb morphology described below is based on buds and on flowers before or just at anthesis; the irregular changes in calyx limb morphology after anthesis in some species complicate comparisons between different developmental stages of different species. In the English descriptions below, measurements indicate length unless otherwise indicated. Morphological terms follow Lawrance (1951). The new species described here are treated together and arranged in alphabetical order. Commentary is provided for the previously described species to present notable new observations or to correct previously published information.

These new species were discovered among specimens made by various projects focused on floristic study of tropical forest regions that are not well known to science, with most of the collections made within the last 15 years. Additional collection data for the specimens cited here, as well as information about additional specimens not cited here, are available at <http://www.tropicos.org>, along with high-resolution digital images of the type specimens or reference specimens of the species newly described here and the previously described species keyed here.

Conservation status assessment methodology. The study presented here is taxonomic and floristic: the objective is enumeration of the species that belong to various Rubiaceae genera, and the species that occur in the area of tropical Central and South America. The methods used here correspond only to this objective; thus, this study is based on survey of specimens collected over a number of years using varied survey methods aimed at various objectives. The specimens used here to delineate the range and commonness of these new species were located through a non-exhaustive survey of several herbaria, and except for some field observations of *Schizocalyx condoricus* D. A. Neill & C. M. Taylor by the second author, no exhaustive field studies have been done targeting the occurrence of these species where they are known or expected to grow. Thus, the floristic information presented here is a simplified presence report based on incomplete survey of the available data, which are uneven and incomplete for this region (Schulman et al., 2007). Knowledge of the true geographic range and the population size and dynamics of a species are essential to understanding the threats to its existence, and thus to understanding its actual conservation status; documentation of the existence of a species based on one or several museum collections does not provide adequate data to evaluate these factors. Conservation assessments are provided here for these newly described species using IUCN categories and criteria (IUCN, 2001) based on the totality of our current knowledge. The basis for these assessments in the form of a map and the calculated assessment parameters are available under the corresponding species names at <http://www.tropicos.org> (assessment parameters for each map can be seen using "Show Detail"). The assessment parameters were calculated using the IUCN Rating tool (Moat, 2007) in ArcView GIS 3.2 (ESRI, 1999), with the grid cell size used for calculating area of occupancy varying between 1 and 3.16 km, depending on characteristics of the species and data (IUCN Standards and Petitions Working Group, 2008). These assessments are not being submitted to IUCN for publication on the Red List (<http://www.iucnredlist.org>), and the basis for these assessments should be carefully evaluated by the reader.

Taxonomic Treatment

Schizocalyx Wedd., Ann. Sci. Nat., Bot., sér. 4, 1: 73. 1854, nom. cons. TYPE: *Schizocalyx bracteosus* Wedd.

Phitopis Hook. f., Hooker's Icon. Pl. 11: 75. 1871. TYPE: *Phitopis multiflora* Hook. f. [= *Schizocalyx multiflorus* (Hook. f.) Kainul. & B. Bremer].

Trees and shrubs. *Leaves* opposite or verticillate, isophyllous, entire, without domatia; higher order venation not lineolate; stipules calyptrate (i.e., fused into a sheathing cap), conical in bud, entire, splitting along 1 or 2 sides as leaves emerge, caducous. *Inflorescences* terminal, cymose to thyrsiform, multiflowered, bracteate. *Flowers* bisexual, homostylous, protandrous, sessile to pedicellate, fragrant; *calyx* limb calyptrate and splitting irregularly or tubular and truncate to 4- or 5-denticulate, when tubular sometimes with petaloid calycophylls; *corolla* campanulate to funnelform or tubular, pale green, white, pink, or white flushed with purple, internally with tufted pubescence at stamen attachment, lobes 5, convolute, without abaxial appendages; stamens 5, inserted in upper part of corolla tube, filaments

generally glabrous in upper part and pubescent in lower part, anthers narrowly ellipsoid-oblong, dorsifixed, exserted; stigmas 2, linear, stout, exserted; ovary 2-locular, ovules numerous on axile placentas. *Fruit* capsular, loculicidal across apical part, ellipsoid to subglobose or turbinate, 2–10 × 2–10 mm, chartaceous to woody, with calyx limb persistent; seeds small, flattened to angled.

Schizocalyx includes nine species found in wet to moist forests from low to middle elevations from Nicaragua through Colombia to Bolivia and into southeastern Brazil.

KEY TO SPECIES OF *SCHIZOCALYX*

1a. Calyx limb 6–12 mm long, > 6 mm long on at least some flowers; corolla with lobes 6–10 mm long.
  2a. Leaves subsessile to shortly petiolate, the petioles to 5 mm long; inflorescences congested to subcapitate, with flowers subsessile to pedicellate, the pedicels to 5 mm long ..... 4. *S. multiflorus*
  2b. Leaves petiolate, the petioles 4–20 mm long; inflorescences lax, with flowers pedicellate, the pedicels 1–20 mm long, > 5 mm long on at least some flowers ..... 7. *S. sterculioides*
1b. Calyx limb 1–7 mm long, on most flowers < 6 mm long; corolla with lobes 2.5–6 mm long.
  3a. Inflorescences with 1 or more flowers bearing a white petaloid calycophyll (these structures often deciduous after anthesis); corolla tube > 2× as long as lobes, the tube 7–8 mm long, the lobes 1.5–3.5 mm long .. .. 1. *S. bracteosus*
  3b. Inflorescences with no flowers with calycophylls; corolla tube shorter than, equal to, or up to 2× as long as lobes, the tube 1–6 mm long, the lobes 3–6 mm long.
    4a. Calyx limb open in bud, truncate or regularly denticulate with teeth up to 0.4 mm long, the limb sometimes tardily enlarging and irregularly splitting (sometimes appearing calyptrate if not observed carefully).
      5a. Corolla lobes 6–9 mm long; plants of southeastern Brazil ..... 3. *S. cuspidatus*
      5b. Corolla lobes 4–5 mm long; plants of the Andes.
        6a. Leaves acute to obtuse at base, with petioles 5–20 mm long; stems and leaves glabrescent to strigose or strigillose (i.e., with appressed pubescence); corolla with tube 2–3 mm long .... 5. *S. obovatus*
        6b. Leaves obtuse to rounded or truncate at base, with petioles 3–13 mm long; stems and leaves pilose to hirsute (i.e., with spreading pubescence); corolla with tube ca. 1 mm long .... 8. *S. truncatus*
    4b. Calyx limb calyptrate in bud (i.e., fused into a sheathing cap), splitting irregularly or sometimes into regular lobes as corolla emerges, lobes 0.6–3.5 mm long.
      7a. Flowers arranged in congested to subcapitate groups, all subsessile to shortly pedicellate, the pedicels to 1 mm long (but sometimes elongating as fruits develop); calyx becoming regularly to irregularly lobed ..... 6. *S. peruvianus*
      7b. Flowers arranged in rather lax cymes, each cyme with some flowers sessile to subsessile and most flowers pedicellate, the pedicels to 15 mm long; calyx becoming irregularly lobed or split.
        8a. Leaves opposite or more often ternate; pedicels 0.5–4 mm long; Ecuador and Peru .... 2. *S. condoricus*
        8b. Leaves opposite; pedicels 5–15 mm long; Costa Rica and Panama ..... 9. *S. veraguensis*

1. Schizocalyx bracteosus Wedd., Ann. Sci. Nat., Bot., sér. 4, 1: 74. 1854. *Bathysa bracteosa* (Wedd.) Delprete, Brittonia 49(4): 481, fig. 1. 1997. TYPE: Colombia. Boyacá: Río Mayo, 1844, *J. P. Goudot 6* (holotype, P not seen, F photo neg. #37199 at MO).

Schizocalyx hirsutus Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 4: 266. 1929. TYPE: Colombia. Santander: betw. Nariño & El Tambor, 150–300 m, 4 Dec. 1926, *E. P. Killip & A. C. Smith 14959* (holotype, US-1350921; isotypes, F not seen, W not seen).

Distribution and habitat. *Schizocalyx bracteosus* is found from northwestern Colombia to central Peru at 300–1000 m (Delprete, 1997).

Discussion. The calyx limbs are tubular in bud, and appear to be closed with the short calyx teeth closely set together or possibly fused. Then as the corolla emerges, the calyx variously remains tubular and denticulate (e.g., *B. Berlin 2020*, MO; *Gentry 9059*, MO), or splits irregularly into two to five lobes with the denticulate teeth irregularly distributed on them (e.g., *Lawrance 513*, MO; *Cogollo 402*, MO). Some inaccurate morphological observations made about this species are detailed in the introductory portion of this article; several of these are included in the description by Delprete (1997).

2. Schizocalyx condoricus D. A. Neill & C. M. Taylor, sp. nov. TYPE: Ecuador. Zamora-Chinchipe: Cordillera del Cóndor, vertiente occidental, cuenca del Río Quimi, formación rocosa arenisca, 3°35′S, 78°25′W, 1180–1400 m, 5 Apr. 2006, *W. Quizhpe 2120* (holotype, LOJA; isotypes, HUT, MO-6253358, QCNE-203691). Figure 1D, E.

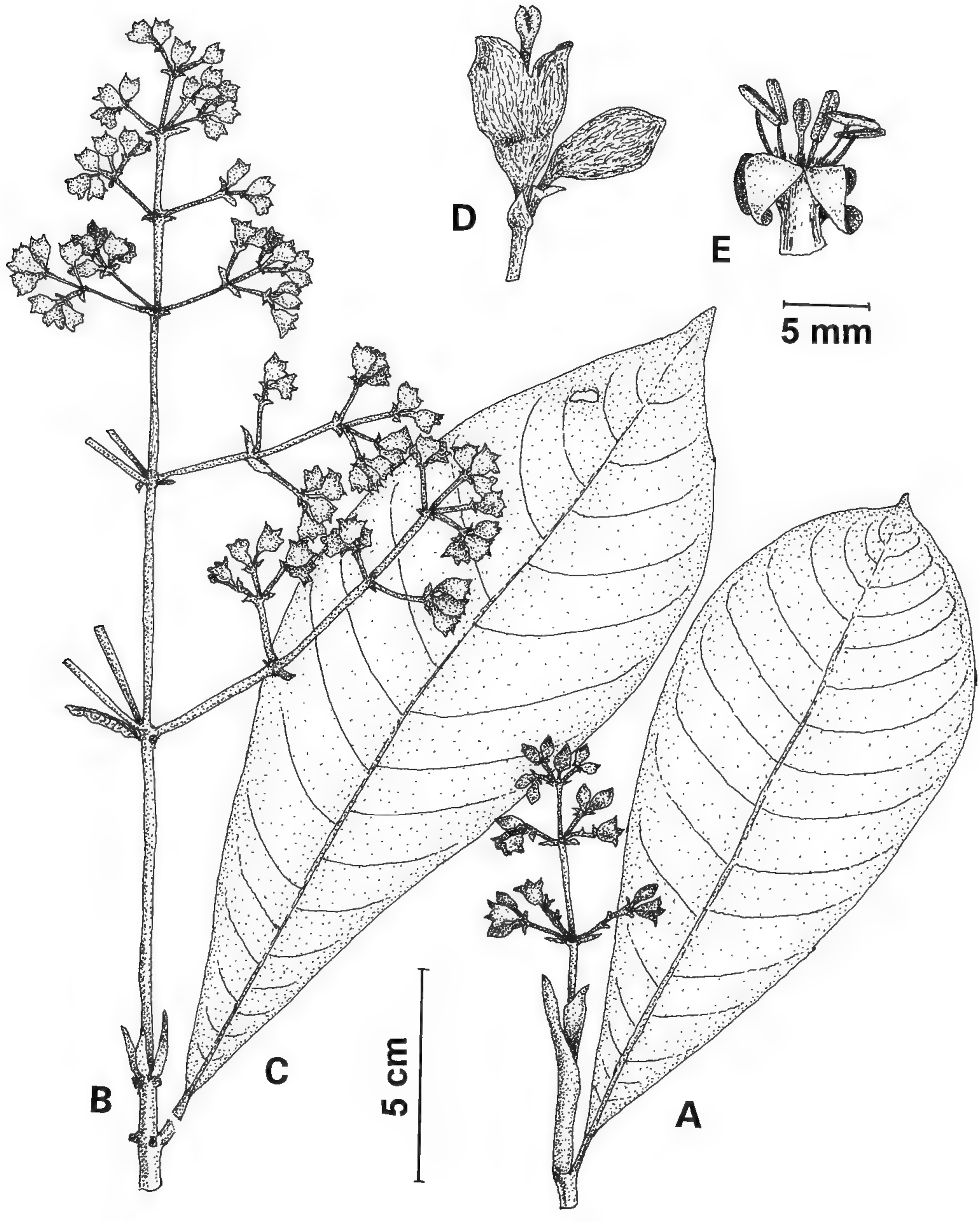

Figure 1. A–C. *Schizocalyx peruvianus* (K. Krause) Kainul. & B. Bremer. —A. Portion of stem with young inflorescence and stipules. —B. Portion of stem with infructescence with young and mature fruits. —C. Leaf (from a different specimen than shown in B). D, E. *Schizocalyx condoricus* D. A. Neill & C. M. Taylor. —D. Small portion of inflorescence with one flower bud (right-hand side) and one mature flower with corolla, anthers, style, and stigmas removed. —E. Portion of flower at anthesis with corolla, anthers, style, and stigmas. A, B based on *I. Sánchez V. & M. Dillon 8953* (MO); C based on *C. Díaz et al. 8034* (MO); D, E based on *D. Neill et al. 15205* (MO). A–C to same 5 cm scale; D, E to same 5 mm scale.

Haec species a congeneris limbo calycino spathaceo interne sericeo 4–7 mm longo, corollae tubo 4.5–5 mm longo lobis 4–5 mm longis atque foliis ternatis coriaceis venatione tertiaria quaternariaque inter sese arcte reticulatis utrinque plana vel leviter elevata distinguitur.

Trees, flowering at 5 m tall, to 15 m tall; stems densely puberulous to strigillose, lenticellate, channeled (at least when dry). *Leaves* ternate or occasionally opposite, obovate to elliptic, 10.5–28 × 5–16 cm, at apex rounded to acute and sometimes shortly acuminate with tips 2–8 mm, at base acute to obtuse, adaxially and abaxially moderately to densely puberulous, drying stiffly chartaceous to subcoriaceous; secondary veins 11 to 14 pairs, tertiary and

higher order venation plane to thinly prominulous on both surfaces; *petioles* 12–30 mm, often thickened at base; stipules calyptrate, in bud slenderly conical, to 35–45 mm, densely strigillose to sericeous, caducous. *Inflorescences* terminal, paniculate, densely strigillose to velutinous-strigillose, branched to 4 orders, sessile or with peduncles 7–11 cm; branched portion pyramidal in outline, 10–30 × 15–25 cm; bracts lanceolate, 2–6 mm, acute, adaxially glabrous, abaxially densely velutinous-strigillose; pedicels 0.5–4 mm. *Flowers* subsessile to pedicellate in dichotomous cymules of 3 to 7; *calyx* densely velutinous-strigillose externally, hypanthium portion obconic, 2.5–3 mm, limb spathaceous and closed in bud, 4–7 mm, splitting irregularly for up to half its length into 2 to 4 lobes, internally densely sericeous; *corolla* salverform, white, externally glabrous, internally glabrous except near base of each lobe with a dense group of straight trichomes 1–2 mm, tube 4.5–5 mm, lobes 5, obovate to oblanceolate, 4–5 mm, rounded; stamens exserted, filaments ca. 4 mm, densely villosulous on lower portion, anthers 2.5–3 mm, dorsifixed a little below middle; stigmas 2, flattened, stout, ca. 2 mm, exserted on styles ca. 7 mm. *Capsules* turbinate, ca. 4 × 4 mm (not including persistent calyx limb), woody, flat on top, opening via a slit across the top; seeds angled, 0.2–0.5 mm.

Distribution, habitat, and phenology. *Schizocalyx condoricus* is known from central through southern Ecuador at 350–2000 m, mainly on substrates derived from crystalline sandstone rocks and in particular rocks of the Cretaceous sandstone Hollín Formation in the Cordillera del Cóndor and the Cordillera del Cutucú to the east of the Andes in Morona-Santiago and Zamora-Chinchipe provinces. It has not been recorded in Peru, but some of the Ecuadorian populations are less than 5 km from the border with Peru and it very likely also occurs in Amazonas Department, Peru. It has been collected in flower in January, March–May, July, October, and December, and in fruit May, July, October, and December, often concurrently with the flowers.

IUCN Red List category. Field observations by the second author indicate that all of the known subpopulations of *Schizocalyx condoricus* occur on substrates associated with the sandstone Hollín Formation, which is found as discontinuous outcrops at 350–2000 m elevation in southeastern Ecuador. The total estimated area covered by this appropriate habitat may thus be taken as the maximum area of occurrence (AOO) of this species, and less than 2000 km² but greater than 500 km². The calculated extent of occurrence (EOO) of the species from herbarium specimens is greater than 5000 km² but less than 20,000 km². The species occurs mostly in relatively isolated subpopulations, separated by 20 km or more from other subpopulations and thus beyond the normal range of seed dispersal for a small-seeded, wind-dispersed species, so the global population may be considered severely fragmented. This new species is quite common in many sites where it has been found, with some subpopulations protected in forest reserves controlled by local communities, but other subpopulations will probably be eliminated by mining and agricultural activities within the next two decades (D. Neill, pers. obs.). With an EOO and AOO that both meet the geographic range criterion for Vulnerable (IUCN, 2001), a severely fragmented population, and a projected continuing decline in its area of occupancy, area and quality of habitat, number of subpopulations, and number of mature individuals, this species is here evaluated as Vulnerable (VU B1ab[ii,iii,iv,v]+2ab[ii,iii,iv,v]).

Discussion. *Schizocalyx condoricus* can be recognized by its spathaceous, internally sericeous calyx limbs 4–7 mm long, its corollas with the tubes 4.5–5 mm long and the lobes 4–5 mm long, and its ternate, leathery leaves with the tertiary and quaternary venation closely reticulated and flat or only thinly raised on both surfaces. The specific epithet refers to the type locality in the Cordillera del Cóndor.

This new species has been confused with *Schizocalyx peruvianus*; this latter species can be separated by its deciduous inflorescence bracts 4–8 mm long; its sessile to subsessile or very shortly pedicellate flowers borne in congested to subcapitate groups; its calyx limbs that are regularly lobed in bud on many flowers (though irregularly so on some flowers of an inflorescence); its smaller corollas with the lobes similar in size to those of *S. condoricus*, but the tube half as long or shorter; and its pilose to pilosulous pubescence on the stems and leaves.

Paratypes. ECUADOR. **Morona Santiago:** Gualaquiza, Cordillera del Cóndor, Cuangos [sic], 20 km E Gualaquiza, *A. Gentry 80273* (MO); valle del río Quimi, *W. Quizhpe & A. Wisum 2660* (HUT, LOJA, MO, QCNE); Limon Indanza, end of rd. in construction Limón La Unión, ca. 10 km from Limón, *G. Harling & B. Ståhl 26728* (MO, S); Parroq. Santa Susana, Kuankus, NO comunidad Shuar camino Cerro Chuank Naint, *T. Katan, C. Morales & J. Nu 296* (MO); Cordillera del Cóndor, cuenca del Río Coangos, centro Shuar Maikuants, Cerro Wishiwishi Naint, *C. Kajekai & grupo Shuar de conservación 315* (MO, QCNE); al O del Río Zamora, parroq. Santa Susana de Chiviaza, alrededores de población El Pescado, *C. Morales & D. Reyes 1756* (MO); centro Shuar Yunkumas, Cerro Kunkuk Naint, *C. Morales, A. Wisum & C. Kajekai 1586* (MO), *A. Wisum & grupo Shuar de conservación 389* (MO, QCNE); Morona, Cordillera de Cutucú, Centro Shuar Uunsuants/Transkutuku, *W.*

Palacios, N. Jaramillo & F. Nicolalde 15770 (MO); Taisha, Cordillera del Cutucú, parroq. Macuma, en la vertiente NE, Centro Shuar Wisui, cima del Cero Wisui, *A. Wisum & C. Kajekai 1140* (MO); Tiwintza, Cordillera del Cóndor, Cordillera Kampa Naint, Centro Shuar Kaputna, al S del río Santiago, Cerro Kaputna, *C. Kajekai 1117* (MO); Cordillera de Shaimi of the Cordillera de Cutucú, just N of where Santiago Morona rd. crossed crest, *D. Neill, C. Kajekai & J. Zuleta 16375* (LOJA, MO, QCNE). **Zamora-Chinchipe:** El Pangui, Cordillera del Cóndor, Parroq. Tundayme, valle del río Quimi, *C. Morales & D. Reyes 1919* (MO), *W. Quizhpe & F. Luizier 1997* (HUT, LOJA, MO, QCNE), *W. Quizhpe & F. Luisier 2088* (HUT, LOJA, MO, QCNE), *W. Quizhpe 2818* (LOJA, MO, QCNE), *W. Quizhpe 2716* (LOJA, MO), *W. Quizhpe & R. Steeves 3077* (LOJA, MO, QCNE); valle del Wawaime, afluyente río Quimi, *C. Morales & D. Reyes 2014* (MO), *D. Neill & NSF Dendrology course 15527* (HUT, LOJA, MO, QCNE), *D. Neill, C. Davidson & S. Christoph 15913* (LOJA, MO, QCNE), *D. Neill, O. Montiel, J. Aronson, N. Revelo & D. Cueva 16364* (LOJA, MO, QCNE), *D. Reyes & C. Morales 1204* (MO), *D. Reyes & C. Morales 1235* (MO, QCNE), *W. Quizhpe, C. Juanga & L. Mayacu 2752* (LOJA, MO, QCNE); Nanagaritza, Cordillera del Cóndor, ca. comunidad Las Orquídeas, terraza del río Nangaritza, *C. Kajekai 946* (HUT, LOJA, MO, QCNE); destacamento militar Miazi, río abajo confluencia río Chumbiriatza & río Nangaritza, *J. Jaramillo 14401* (MO, QCA), *W. Quizhpe, F. Santín, O. Jadán & M. Chiunda 698* (LOJA, MO); near Cabañas Yankuam lodge, "Area de Conservación Los Tepuyes," *D. Neill, M. Asanza & W. Quizhpe 15157* (MO), *D. Neill, C. Davidson, S. Christoph & W. Quizhpe 15767* (MO, QCNE); upper Río Nangaritza, Las Orquídeas reserve on W side of river, *D. Neill, M. Asanza & Univ. Central botany students 15203* (HUT, MO, QCNE), *15205* (HUT, MO, QCNE); ca. 13 km S Guayzimi, silica mine "La Daniela," *D. Neill, C. Davidson, S. Christoph & W. Quizhpe 15752* (MO, QCNE); valle del río Nanagaritza & faldas Cordillera del Cóndor, Pachicutza, *W. Palacios & D. Neill 6573* (MO, QCNE), *W. Palacios, G. Aymard & E. Freire 8355* (MO, QCNE); parroq. Surmi, comunidad Yawi, *W. Quizhpe, V. Tranda, D. Veintimilla, H. Salas & P. Wampash 1543* (MO); Yacuambi, Cordillera Oriental de los Andes, Parroq. la Paz, Centro Shuar Washikiat, Res. Micha Nunka, *C. Kajekai & A. Wisum 1293* (MO), *A. Wisum & C. Kajekai 1072* (MO); Yantzaza, Cordillera del Cóndor, carr. Los Encuentros hacia Cerro Machinaza, *W. Quizhpe 1665* (MO).

3. Schizocalyx cuspidatus (A. St.-Hil.) Kainul. & B. Bremer, Amer. J. Bot. 97(12): 1976. 2010. Basionym: *Exostema cuspidatum* A. St.-Hil., Pl. Usuel. Bras., 1(3): 1, t. 3A. 1824. *Schoenleinia cuspidata* (A. St.-Hil.) Klotzsch, Getreue Darstell. Gew. 14: t. 15. 1846. *Cinchona cuspidata* (A. St.-Hil.) Brign., Mem. Mat. Fis. Soc. Ital. Sci. Modena, Pt. Mem. Fis. 2, 1: 63. 1862. *Bathysa cuspidata* (A. St.-Hil.) Hook. f. ex K. Schum., Fl. Bras. 6(6): 237. 1889. TYPE: Brazil, Minas Geraes, cueilli dans les bois près Itajura, Cap des Moines, 1816–1821, *A. Saint-Hilaire Catal. B' No. 970* (lectotype, selected here, P-00752481; duplicates of lectotypes, F-0069068, P-00752482, P-00752483).

Distribution and habitat. *Schizocalyx cuspidatus* is found in southeastern Brazil (Germano Filho, 1998), where it grows in mesophyllous forest and gallery forest.

Discussion. There are at least three duplicates of the type collection made by St.-Hilaire at P, two with flowering branches and one with only a leaf. The lectotype specimen selected here has a flowering branch with a mature leaf and two labels, one a handwritten label with the locality information for this collection, and the other a printed label that identifies the specimen as part of the set from St.-Hilaire's expedition to Brazil and has its catalog number and its scientific name. One of the other specimens has a flowering branch with two leaves, and only the handwritten label with locality information; the other specimen has a single leaf, and only the printed label.

4. Schizocalyx multiflorus (Hook. f.) Kainul. & B. Bremer, Amer. J. Bot. 97(12): 1976. 2010. *Phitopis multiflora* Hook. f., Hooker's Icon. Pl. 11: 75, t. 1093. 1871. TYPE: Peru. San Martín: prope Tarapoto, montis Campana, Dec. 1855, *R. Spruce 4319* (lectotype, selected herein, K-000200475; duplicates of lectotypes, B†, F photo neg. #61 at MO, K-000200474) [Syntype: Peru, Moyobamba, *Mathews 1639*, K].

Distribution and habitat. *Schizocalyx multiflorus* is found in central Peru (Taylor & Pool, 1993), where it grows in wet forests at 900–1600 m.

Discussion. The collection *Spruce 4319* was chosen as the lectotype by Standley (1936: 67), who cited this collection as the type but did not select an individual specimen. His selection was logical, because this collection has two good specimens at K and had another duplicate at B, versus one of the Mathews collection (Peru, Moyobamba, *Mathews 1639*, K). *Spruce 4319* is the only specimen of this species cited by Schumann (1889); a photograph of this specimen was widely available for comparison for some years while the Mathews collection could only be seen by visiting K. Of the two specimens of *Spruce 4319* at K, where Hooker worked, the lectotype specimen designated here is chosen because it has more plant material and extensive analytical drawings of its floral structures.

5. Schizocalyx obovatus (K. Schum. ex Standl.) Kainul. & B. Bremer, Amer. J. Bot. 97(12): 1976. 2010. Basionym: *Bathysa obovata* K. Schum. ex Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 7(3): 280. 1931. TYPE: Peru. Huánuco: Chico-

playa, 1798, *J. J. Tafalla s.n.* (holotype, B†, F photo neg. #33 at MO; isotypes, F not seen, MA not seen, F photo neg. #29653 at MO).

Distribution and habitat. *Schizocalyx obovatus* is known from northern Peru to central Bolivia (Rea Romero, 1993; Taylor & Pool, 1993), in wet forests at 290–1700 m. This species has also been reported from Ecuador (Neill & Ulloa, 2011) based on an identification made in 1999, before *Schizocalyx* had been studied; this report has not been reconfirmed by all of the authors of this article.

Discussion. This species name was first mentioned by Krause (1908), who contrasted his new species *Bathysa peruviana* with a species he called "*B. obovata* (Ruiz & Pavon) K. Schumann," which was based on his "*Macrocnemum obovatum* Ruiz ex Standl.," a name that was written on some specimens of Ruiz and Pavón. However, Ruiz and Pavón did not publish the name written on their specimens, and Schumann did not publish his name in *Bathysa*, and Krause did not validly publish this name. This name is not lectotypified here, because further documentation of potential type materials is needed before a selection can be made, but that work is outside the scope of this present review.

Some inaccurate morphological observations made about this species are detailed in the introductory portion of this article. This species as circumscribed here is somewhat variable morphologically, in particular in its opposite versus ternate leaf arrangement and somewhat variable flower and fruit size. The leaf arrangement varies throughout the range of this species, but there appears to be some clinal variation in flower size: the largest flowers are found on plants in Bolivia and southern Peru, while the smallest flowers are found on plants in northern Peru.

6. Schizocalyx peruvianus (K. Krause) Kainul. & B. Bremer, Amer. J. Bot. 97(12): 1976. 2010. Basionym: *Bathysa peruviana* K. Krause, Verh. Bot. Vereins Prov. Brandenburg 50: 96. 1909. TYPE: Peru. Loreto: prope Yurimaguas, Apr. 1903, *E. Ule 6768* (holotype, B†, F photo neg. #32 at MO).

Distribution and habitat. *Schizocalyx peruvianus* is found from northern Ecuador to southern Peru (Taylor & Pool, 1993; Taylor, 1999), in wet forests at 200–1600 m.

Discussion. Some inaccurate morphological observations made about this species are detailed in the introductory portion of this article. This species is characterized by its rather dense inflorescences with the flowers sessile to very shortly pedicellate and borne in subcapitate to congested groups. However, the inflorescence axes and pedicels sometimes elongate as the fruits develop, so the infructescences are often laxer than the inflorescences and have the fruits separated from each other, presumably to aid dispersal of the seeds (Figure 1A–C). There also appears to be some clinal variation in degree of expansion of the inflorescences and infructescences, with these shorter and more congested in Ecuador and northern Peru, and often longer and laxer in central and southern Peru. This name is not lectotypified here, because further documentation of potential type materials is needed before a selection can be made, but that work is outside the scope of this present review.

Selected specimens examined. PERU. **Amazonas:** Bagua, distrito Imaza, Comunidad Aguaruna de Wanás (Km. 92 Carretera Bagua-Imacita), Cerros Chinim, *C. Díaz, A. Peña, L. Tsamajain & M. Roca 8034* (MO). **San Martín:** Rioja, Aguas Verdes (Perla del Mayo-Laguna Onarcocha), *I. Sánchez V. & M. Dillon 8953* (F, MO).

7. Schizocalyx sterculioides (Standl.) Kainul. & B. Bremer, Amer. J. Bot. 97(12): 1976. 2010. Basionym: *Phitopis sterculioides* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 8: 341. 1931. TYPE: Peru. Junín: dense forest, Pichis Trail, Enenas, 1600–1900 m, 30 June–2 July 1929, *E. P. Killip & A. C. Smith 25747* (holotype, F-607646 F photo neg. #44915 at MO).

Distribution and habitat. This species is known from southern Ecuador through central Peru (Taylor & Pool, 1993; Neill & Ulloa, 2011), where it is found in wet premontane forests at 1100–1800 m. It has been documented on substrates derived from crystalline rocks (e.g., *D. Neill & Shuar Conservation Interns 14035*, MO) and also on clay soils (e.g., *K. Young & G. Sullivan 747*, MO).

8. Schizocalyx truncatus C. M. Taylor, sp. nov. TYPE: Peru. Pasco, Oxapampa, distr. Palcazú, El Paujil, lowland rainforest, 10°10′24″S, 75°15′49″W, 500 m, *H. van der Werff, R. Vásquez & R. Francis 19999* (holotype, USM; isotype, MO-04824519). Figure 2.

Haec species a *Schizocalyce obovato* (K. Schum. ex Standl.) Kainul. & B. Bremer caulibus foliis stipulisque pubescentia pilosa hirsutave indutis, foliis ad basem interdum obtusis sed plerumque rotundatis truncatisve atque tubo corollino breviore distinguitur.

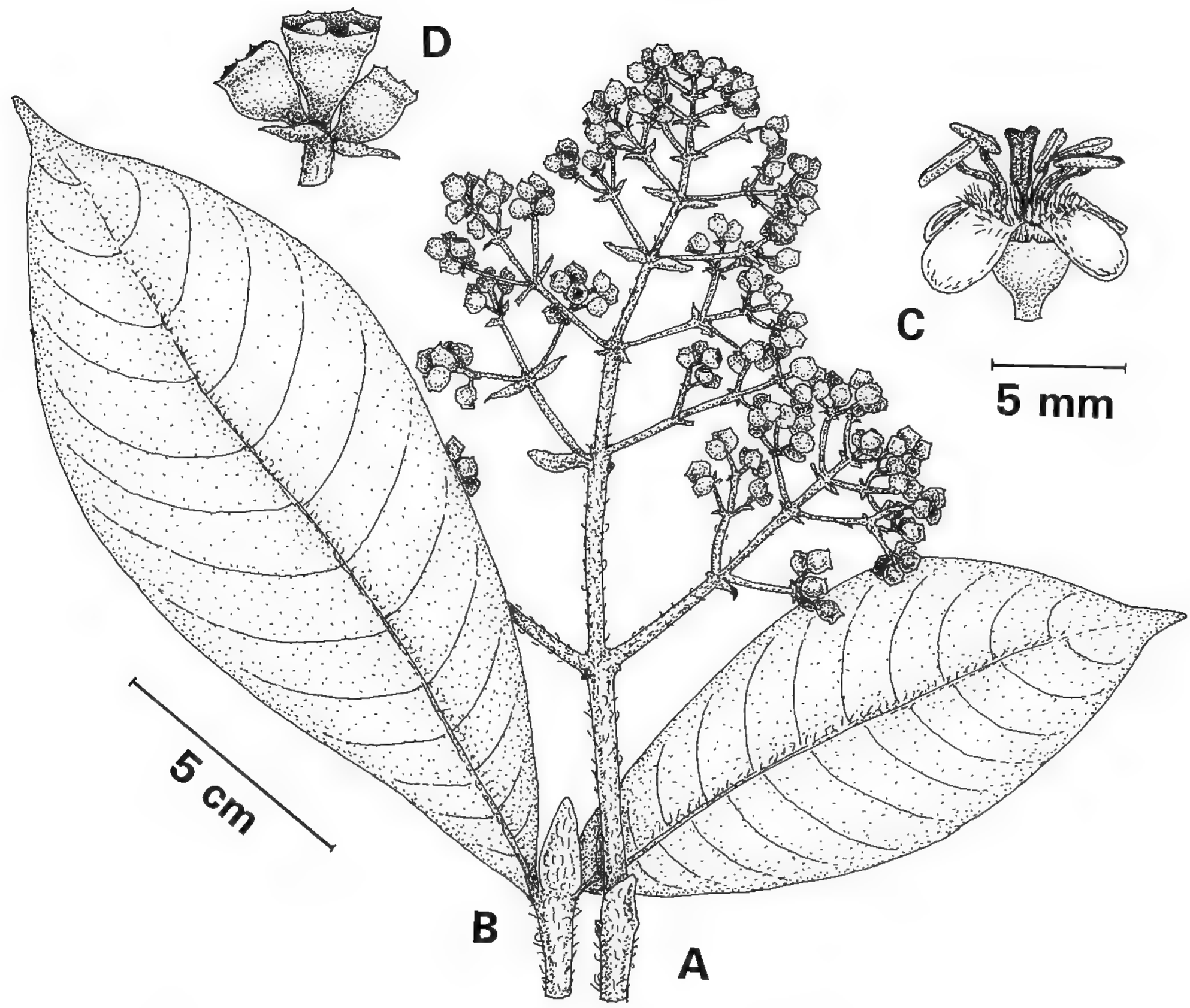

Figure 2. *Schizocalyx truncatus* C. M. Taylor. —A. Portion of stem with infructescence. —B. Portion of vegetative stem with apical stipule present. —C. Flower at anthesis. —D. Portion of infructescence with one mature capsule (center) and two immature fruits (sides). A, B based on *W. Pariona & A. Sebastián 60* (MO); C, D based on *A. Gentry et al. 25641* (MO). A, B to same 5 cm scale; C, D to same 5 mm scale.

Trees, flowering at 5 m tall, to 16 m tall; stems densely hirsute to pilose. *Leaves* opposite, obovate, 13–31 × 6–16 cm, at apex acute to abruptly acuminate with tips 3–10 mm, at base tapered then shortly obtuse to usually rounded or truncate, adaxially moderately to densely pilose, abaxially densely pilose with trichomes denser and longer on principal veins, drying stiffly chartaceous; secondary veins 13 to 16 pairs, tertiary and higher order veins plane above, prominulous to prominent below; *petioles* 3–13 mm, densely pilose; *stipules* calyptrate, conical to ellipsoid and laterally flattened, 20–22 mm, densely strigose to hirsute, caducous. *Inflorescences* terminal, paniculate, densely velutinous and also sparsely to densely pilosulous to pilose (i.e., with trichomes of two lengths), branched to 3 or 4 orders, sessile or with peduncles 5–7 cm; branched portion pyramidal in outline, 10–22 × 9–21 cm; bracts triangular to lanceolate or ovate, 2–6 mm, acute, adaxially glabrous, abaxially densely strigillose to puberulous; pedicels 0–1 mm. *Flowers* sessile to shortly pedicellate in dense groups of 5 to 11; *calyx* densely strigillose externally, with hypanthium portion obconic, 1.5–2 mm, limb tubular and open in bud, 1.5–2 mm, internally glabrous, truncate or usually 5-denticulate, with teeth to 0.2 mm; *corolla* salverform, white, externally glabrous, internally glabrous except with a tuft of stiff pilosulous pubescence near base of each lobe, tube ca. 1 mm, lobes 5, ligulate, 4–4.5 mm, rounded; *stamens* exserted, filaments ca. 4 mm, glabrous except with a villous ring of pubescence in basal half, anthers ca. 2 mm, dorsifixed near middle; *stigmas* 2, cylindrical, 1.5–2.5 mm, succulent, exserted, style 2–2.5 mm. *Capsules* turbinate, 4–4.5 × 4 mm, densely strigillose, chartaceous to woody, flat-topped with persistent calyx limb, opening by a slit across the top; seeds angled to somewhat fusiform, 0.2–0.5 mm.

Distribution, habitat, and phenology. This species is known from central Peru, where it is found in wet forests at 350–1185 m; it has been collected in

flower in February, March, May, and June, and in fruit in June.

IUCN Red List category. This species meets the geographic range criterion for an evaluation of Endangered (EN) based on its limited known EOO and AOO. However, it is found in three different legally protected areas, presumably not all under immediate threat. Whether its habitat or populations are in continuing decline is unconfirmed, but this is likely, now or in the near future. This species is here evaluated as Vulnerable due to its few known locations that may have declining habitat (VU D2).

Discussion. This new species can be recognized by its pilose to hirsute pubescence, its leaves that taper to an obtuse or usually shortly rounded to truncate base, and its inflorescences that are branched to several orders with small flowers borne in congested groups. The species epithet refers to the distinctive shape of the leaf bases. This new species is similar vegetatively to *Schizocalyx multiflorus*; that other species differs in its fewer flowers with spathaceous calyx limbs that are ca. 10 mm long and densely velutinous internally (i.e., adaxially). This new species is also similar in its inflorescence and corollas to *S. obovatus*; that other species differs in its shorter, pilosulous pubescence, its leaves with generally longer petioles and cuneate bases, and its densely velutinous to strigillose inflorescence axes with trichomes of generally only one length.

Paratypes. PERU. **Pasco:** Prov. Oxapampa, distr. Iscozacín, Alto, *W. Pariona & A. Sebastián 60* (MO); distr. Palcazú, drainage of río Palcazú betw. Km. 51 & 60 of new rd. in construction NW of Villa Rica toward Puerto Bermudez, *A. Gentry & D. [N.] Smith 35998* (MO); Parque Nac. Yanachaga-Chemillén, ca. de la est. biol. Paujil, *A. Monteagudo, R. Francis & G. Ortiz 5102* (MO); *A. Monteagudo, R. Francis, G. Ortiz & C. Mateo 5139* (MO); Parque Nac. Yanachaga-Chemillén, Cerro Paujil-Ozuz, *A. Monteagudo, A. Peña, R. Francis, H. Cristobal, L. Mateo, A. Utani, T. Ciriaco & R. Roca 8470* (MO), *A. Monteagudo, A. Peña, R. Francis, J. Mateo & A. Utani 8539* (MO), *A. Monteagudo, A. Peña, R. Francis, J. Mateo & A. Utani 8589* (MO); Camino Alto Lagarto a Pozuzo Alto Victoria, *R. Rojas & G. Ortiz 5818* (MO); Res. Comunal Yanesha-Sector Azulis, *R. Vásquez, A. Monteagudo, A. Peña, R. Francis & L. Mateo 29653* (MO); entre San Pedro de Pichanaz y Puerto Bermúdez, *R. Vásquez, A. Monteagudo, A. Peña, R. Francis & L. Mateo 29824* (MO); El Paujil, *H. van der Werff, R. Vásquez & R. Francis 19962* (MO); distr. Villa Rica, Bosque de Protección San Matías-San Carlos, Sector Yulculmas, *R. Vásquez, A. Monteagudo, A. Peña & J. Mateo 32480* (MO). **San Martín:** Prov. Mariscal Cáceres, distr. Tocache Nuevo, 12 km W Tocache Nuevo, Carr. Marginal, hills overlooking Río Tocache, *A. Gentry, J. Schunke V. & J. Aronson 25619* (MO), *A. Gentry, J. Schunke V. & J. Aronson 25641* (MO); quebrada Tanata, margen izquierda Río Huallaga, *J. Schunke V. 4072* (MO); camino Pushurumbo, 7 8 km E puente de Palo Blanco, *J. Schunke V. 5764* (MO); Pto. Pizana, margen derecha Río Huallaga, *J. Schunke V. 6889* (MO); quebrada Challua-Gacu, *J. Schunke V. 10805* (MO).

9. Schizocalyx veraguensis (Dwyer) Kainul. & B. Bremer, Amer. J. Bot. 97(12): 1976. 2010. Basionym: *Bathysa veraguensis* Dwyer, Ann. Missouri Bot. Gard. 67: 40. 1980. TYPE: Panama. Veraguas: Cerro Tute, 1200 m, 28 Sep. 1972, *E. A. Lao & A. Gentry 531* (holotype, MO-2164349; isotypes, BM not seen, MEXU not seen, NY not seen, PMA not seen).

Distribution and habitat. *Schizocalyx veraguensis* species is found from northeastern Costa Rica through central Panama (Dwyer, 1980; Burger & Taylor, 1993), in wet forests at 500–1000 m.

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Hoya ignorata (Apocynaceae, Asclepiadoideae): An Overlooked Species Widely Distributed across Southeast Asia

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ABSTRACT. A new species, *Hoya ignorata* T. B. Tran, Rodda, Simonsson & Joongku Lee (Apocynaceae, Asclepiadoideae) is described and illustrated from Vietnam. The new taxon, widely distributed in Southeast Asia, does not seem to be related to any previously described *Hoya* R. Br., due to its small cupular coronas lacking lobes, and pendulous pollinia. These morphological characters, new for the genus *Hoya*, are discussed in light of the recent broadening of the circumscription of the genus following the results of molecular phylogenies and morphological studies.

Key words: Apocynaceae, *Hoya*, IUCN Red List, Malaysia, Sabah, Thailand, Vietnam.

The genus *Hoya* R. Br. (Apocynaceae, Asclepiadoideae) comprises approximately 200 species distributed from India across Southeast Asia and the Pacific Islands (Li et al., 1995). The plants are often used for ornamental purposes and are popular because of their beautiful and fragrant flowers. The new species, described herein, was first identified among the collections from dry forests of Dak Mil, Dak Lak Province, Vietnam. Twenty-one species of *Hoya* have been recognized for Vietnam (Costantin, 1912; Ho, 1993; Li et al., 1995; Tran, 2005, Rodda et al., in prep.). Following field and herbarium-based studies it was also found in other localities in Vietnam, Peninsular Malaysia, Sabah, and Thailand. Peninsular Malaysia contains 26 *Hoya* species (Rintz, 1978, Kiew, 1989). Thailand is rich in *Hoya* species, with ca. 40 taxa (Thaithong, 2001); Borneo is still little explored (Forster et al., 1998), but recent research reveals that many new species still await description (Rodda & Nyhuus, 2009; Rodda et al., 2011; Rodda & Simonsson, 2011a, 2011b). *Hoya* has been recircumscribed following molecular and morphological studies, and its morphological boundaries have been greatly expanded (Wanntorp et al., 2006a, 2006b, 2011; Wanntorp & Forster, 2007, 2009; Wanntorp & Meve, 2011). Rare morphologies such as nonclimbing habit (Simonsson & Rodda, 2009; Rodda & Simonsson, 2011b) and extremely minute flowers (Rodda & Simonsson, 2010) have also been recently observed in an increasing number of species. Despite the peculiar morphology illustrated below, we describe the new species as *H. ignorata* T. B. Tran, Rodda, Simonsson & Joongku Lee. We discuss the novel characters this new species introduces to the genus *Hoya*.

Hoya ignorata T. B. Tran, Rodda, Simonsson & Joongku Lee, sp. nov. TYPE: Vietnam. Dak Lak: Dak Mil, 11 Dec. 1979, *L. K. Bien 1072* (holotype, HN; isotype, MO). Figures 1, 2.

Haec species ab omnibus congeneris corona parva cupulata elobata atque polliniis pendulis distinguitur.

Plants erect or decumbent, epiphytic shrub, glabrous on all parts, 30–50(100) cm; leafy stems 1–3 mm diam., older stems to 10 mm diam.; internodes 2.8–5 cm. Leaves opposite, subsessile, coriaceous, petiole ca. 1 mm; lamina entire; leaf blade ovate, lanceolate-oblong or oblong with wavy margins, 3–7 × 1–3 cm; base acuminate to round; apex acuminate-apiculate; secondary veins in 4 to 8 pairs on each side of midrib, obscure, diverging from the midrib at ca. 90°. Inflorescences extra-axillary, hidden beneath foliage, concave to convex, often with congested flowers, to 20-flowered, lasting ca. 7 days in cultivation; peduncle 5–16 × 1.5–2 mm; pedicels filiform, 3–6 × 1 mm. Flowers 2–2.8 mm diam., ca. 6 mm diam. when flattened; calyx lobes broadly ovate to nearly round, 0.9–1 × 0.8–0.9 mm, apex and base rounded; corolla revolute, fleshy, pale yellow to bright orange-red; corolla lobes triangular, 2.5 × 1 mm, apex acute to acuminate; corona staminal, cupular, fleshy, 2 mm diam., 0.8 mm high, pale yellow to bright orange-red, lacking corona lobes; guide rail prominent, forming a ridge along the corona but extremely reduced; stigma convex, depressed; pollinaria presenting pendulous pollinia, retinaculum extremely small, 100 × 30 μm held on the prominent tip of the guide rail with basally attached caudicles, ribbon-shaped, 400 × 15 μm, connected to 2 round to ovoid pollinia, 350 × 250 μm, positioned at the center of the flower just above the style head; ovary bicarpellate, bottle-shaped, ca. 1 mm long. Follicles thin, ca. 4 × 0.5 cm, seeds comose, spindle-shaped, 4–5 × 1 mm.

Distribution and habitat. *Hoya ignorata* is an epiphyte found in strikingly different environments across Southeast Asia. It was found in Nghê An Province in northern Vietnam to as far south as Nabawan, Sabah. The information on its habitat was gathered from type specimens *Bien 1072* (holotype/isotype) and *Corner 30279* (paratype), and from recent field observations in Vietnam, Thailand, and Sabah. The type was collected in Dak Lak Province in seasonally dry forest. Also, the taxon was recently collected in Hue, Vietnam (Pham Van The, pers. comm.). In Peninsular Malaysia it was collected growing on *Ochanostachys amentacea* Mast. (Olacaceae), a small tree common in primary forests in Malaysia, at ca. 150 m.s.m. The Thai collections are from primary forests in Nakhon Si Thammarat Province at 800 m.s.m. (five individuals on separate trees and one vine) and Songkhla Province (three on individual small trees) at 150 m.s.m., both in dense forest near streams and often very hard to distinguish from the host tree or vine. In Sabah, the species was observed as four specimens growing on a single unidentified tree about 6 m high in lowland primary heath forest dominated by *Dacrydium pectinatum* De Laub. (Podocarpaceae) and *Tristaniopsis* Brogn. & Gris (Myrtaceae). *Hoya ignorata* appears to be surprisingly adaptable to a wide range of environments and forest types, and it is probably much more common than so far known, but rarely collected due to its epiphytic habit and its inconspicuous flowers. Further, it appears to be restricted to primary forest habitats only.

IUCN Red List category. *Hoya ignorata* should be considered Least Concern (LC) according to IUCN Red List criteria (IUCN, 2001). *Hoya ignorata* is known from a vast distributional area spanning from Vietnam to Sabah in Malaysia.

Phenology. *Hoya ignorata* has been observed to flower in December in Dak Lak, and in May in Nghê An (Vietnam), Nakhon Si Thammarat (Thailand), Songkhla (Thailand), and Nabawan, Sabah (Malaysia).

Etymology. The epithet of the new species is derived from the fact that it is easily overlooked both in herbaria and in the field. Its oldest known specimen, *J. F. Fleury 32504* (P), remained unidentified for more than 100 years. In its natural habitat *Hoya ignorata* grows as an epiphyte and can be easily confused with a host tree branch (Fig. 1C, D). Further, its inconspicuous flowers may be difficult to observe when the plants grow high in the tree canopy.

Notes. This taxon has long been known from herbarium materials. First collected by Fleury in Nghê An, Vietnam, in 1914, then by Corner in Peninsular Malaysia in 1934, and again by Bien in Dak Lak, Vietnam, in 1979, these collections remained undetermined until recently. Due to the small size of the flowers and the impossibility to determine their tri-dimensional shape from rehydrated materials, we were fortunate when specimens were collected in Thailand in 2010 and in Vietnam in 2011, and surprisingly in Sabah, Malaysia, which allowed living materials to be measured and photographed for detailed illustration.

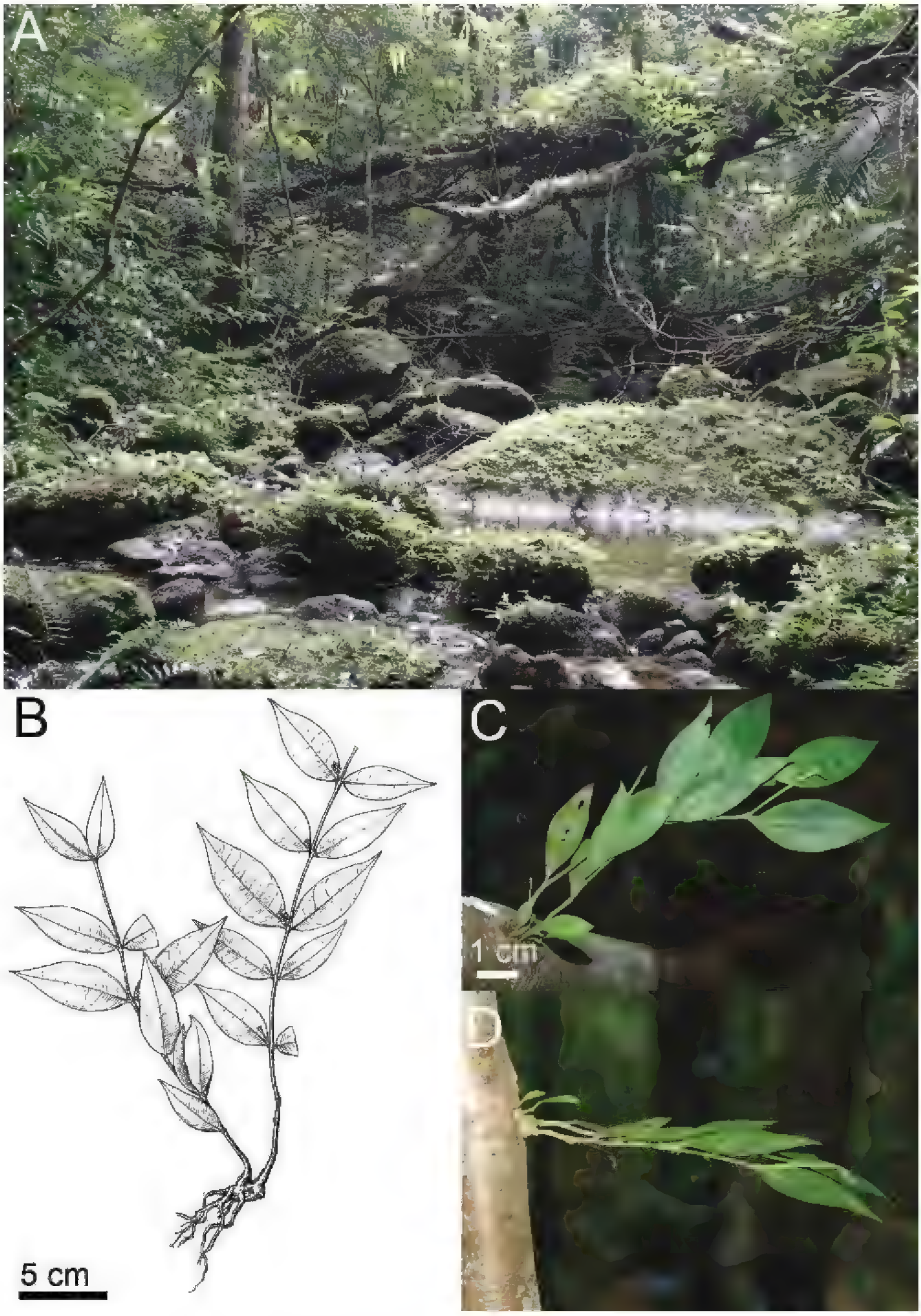

Figure 1. *Hoya ignorata* T. B. Tran, Rodda, Simonsson & Joongku Lee. —A. Habitat in Khao Luang, Thailand, associated with paratypes *Simonsson & Somadee NS10-004*, *NS10-007* (SING). Photo by N. Simonsson. —B. Mature specimen, drawn from the holotype *L. K. Bien 1072* (HN) collected from Dak Lak, Vietnam. —C, D. Habit photographs of the new species in Nabawan, Sabah, Malaysia (photos by M. Rodda).

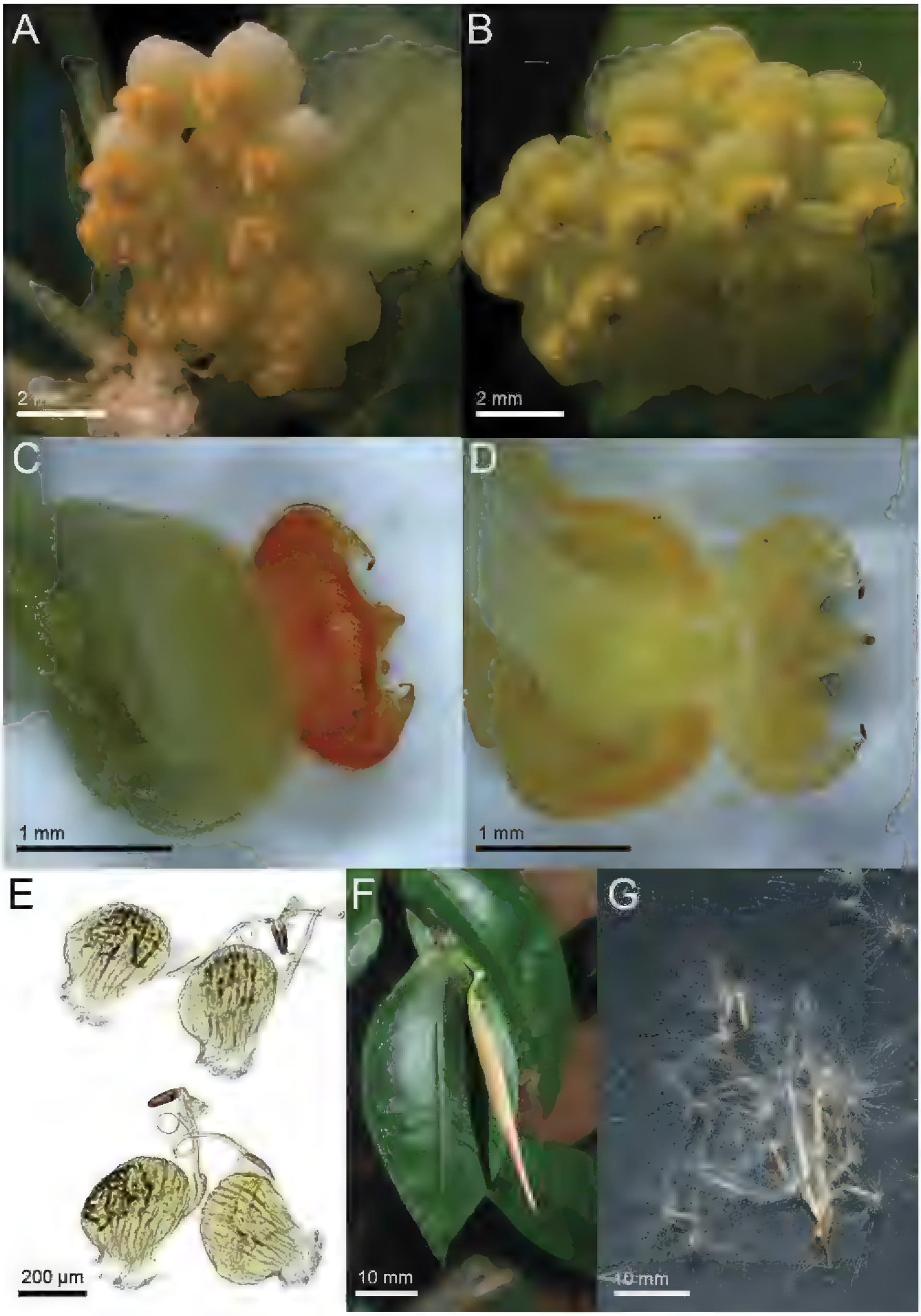

Figure 2. *Hoya ignorata* T. B. Tran, Rodda, Simonsson & Joongku Lee. —A. Convex inflorescence (*Simonsson & Somadee NS10-007*, SING). —B. Inflorescence with congested flowers (*Simonsson & Somadee NS10-004*, SING). —C. Lateral view of a single flower (*Simonsson & Somadee NS10-007*, SING). —D. Longitudinal section of a flower with evident retinacula and depressed stigma. —E. Pollinaria. —F. Follicle (*M. Rodda & L. Gokusing MR11-056*, SING). —G. Seeds (*M. Rodda & L. Gokusing MR11-056*, SING).

Discussion. It became immediately apparent that the taxon was either a new genus closely related to *Hoya* or a very peculiar new species of *Hoya*. *Hoya* is assigned to tribe Marsdenieae within the Apocynaceae. The Marsdenieae cannot be separated from other tribes due to synapomorphies, but its distinguishing characters are recognized as the longitudinal dehiscence of the thecae, the presence of erect or ascending pollinia and anthers with membranous terminal appendages (Omlor, 1996). Within Marsdenieae, *Hoya* belongs to a group described by Omlor (1996) as the *Hoya* group; its members are herbaceous vines or climbing or dependent epiphytes with often fleshy leaves and perennial pseudo-umbelliform inflorescences that produce flowers for several seasons. The corona is staminal and has lobes that often spread horizontally, and generally consist of an inner tip that is appressed to the anthers and a variable outer part with revolute lateral margins. The seeds are comose and spindle-shaped and lack differentiated margins, and the pollinia have a conspicuous, pellucid germination zone on their outer margin (Schill & Dannenbaum, 1984). This species group is separated from the natural core of Marsdenieae, which consists of woody perennial lianas or twining shrubs with simple staminal coronas (rarely a corolline corona), undifferentiated, erect, elongated pollinia, and flattened, comose, sometimes broadly margined, smooth seeds (Omlor, 1996). Following molecular investigations (Wanntorp et al., 2006a, 2006b, 2011) it became apparent that *Hoya* had to be recircumscribed and also include the monotypic genera *Absolmsia* Kuntze, *Madangia* P. I. Forst., Liddle & I. M. Liddle, and *Micholitzia* N. E. Br., and the two species of *Clemensiella* (Schltr.) Schltr. (Wanntorp & Forster, 2007; Wanntorp & Kunze, 2009; Meve et al., 2010; Wanntorp & Meve, 2011). To determine whether *H. ignorata* was indeed a *Hoya*, we examined morphological characters that identified genera now included in *Hoya* that were once separately considered. In *Absolmsia* this is the lack of leaves, in *Madangia*, the presence of a revolute basal skirt on the corona lobe and the urceolate corolla, and in *Micholitzia*, the small, urceolate corolla. Wanntorp and Forster (2007) clarified how these characters are shared with other *Hoya* species and did not justify the separation as different genera. Similarly, *C. mariae* (Schltr.) Schltr. was found to belong to *Hoya* (Wanntorp et al., 2011), despite bearing fleshy coronas with valvate lobes and clavate pollinia without pellucid margins, small and narrow retinacula, and long, ribbon-shaped caudicles. Unlike *Absolmsia*, *Madangia*, and *Micholitzia*, *Clemensiella* is much more morphologically divergent from the core of *Hoya*, but is still phylogenetically similar to it.

Hoya ignorata possesses only a few common characters that link it to *Hoya*: it is a nonclimbing epiphyte from a habit rarely observed in *Hoya* and probably overlooked, since other new species with this habit have recently been described (Rodda et al., in prep.; Rodda & Simonsson, 2011b). The new taxon presents perennial inflorescences; the seeds are comose, spindle-shaped and lack differentiated margins; the pollinia have a distinct pellucid germination zone. The corona is completely different from that of all *Hoya* species described so far: the corona lobes are entirely missing and the guide rails, often depressed between the ridges of the corona lobes, here are prominent and elevated above all other corona parts, but still much reduced in size. At the tip of these is the minuscule retinaculum from which two pendulous pollinia are attached, via two long, ribbon-shaped caudicles. The retinaculum and caudicles of *H. ignorata* are very similar to those of the two species formerly belonging to *Clemensiella*: *H. mariae* (Schltr.) L. Wanntorp & Meve and *H. omlorii* (Livsh. & Meve) L. Wanntorp & Meve (Wanntorp & Meve, 2011).

It is apparent that various *Hoya* species present uncommon morphologies for the genus and the assignment of *H. ignorata* to the genus can be therefore justified. *Hoya ignorata* presents a combination of uncommon characters already observed in other *Hoya* species such as nonclimbing habit and long, ribbon-shaped caudicles. The lack of corona lobes and pendulous pollinia is so far unseen in *Hoya*. The presence of pendulous pollinia is often the only character that has distinguished the Asclepiadeae from Marsdenieae (Bruyns & Forster, 1991) and will have to be reconsidered in light of the publication of *H. ignorata*.

Due to the unique morphology of *Hoya ignorata* it is impossible to compare it to similar *Hoya* species. Only *H. minutiflora* Rodda & Simonsson (2010) presents flowers of a comparable small size, but can be easily separated because it is a climbing epiphyte whose flowers present bilobed corona lobes. Morphological comparison between *H. ignorata* and other Asian *Hoya* species presenting divergent morphologies is presented in Table 1.

Paratypes. MALAYSIA. **Sabah:** Nabawan, 300 m.s.m., 13 June 2011, *M. Rodda & L. Gokusing MR11-056* (SING). **Terengganu:** Kenaman, Bukit Kajang, 150 m.s.m., 6 Nov. 1935, *E. H. J. Corner 30279* (SING). THAILAND. **Nakhon Si Thammarat:** Khao Luang, 800 m.s.m., 5 May 2010, *N. Simonsson & S. Somadee NS10-004* (SING), 810 m.s.m., 6 May 2010, *N. Simonsson & S. Somadee NS10-007* (SING).

Table 1. Morphological comparison of *Hoya ignorata* with *H. inflata* (P. I. Forst., Liddle & I. M. Liddle) L. Wanntorp & P. I. Forst., described from Madang, Papua New Guinea, *H. manipurensis* Deb from Manipur, India, *H. spartioides* (Benth.) Kloppenb. from Borneo, Malaysia, and *H. mariae* (Schltr.) L. Wanntorp & Meve from the Philippines.

	H. ignorata	*H. inflata*	*H. manipurensis*	*H. spartioides*	*H. mariae*
Habit	epiphytic shrub	epiphytic climber	epiphytic shrub	epiphytic shrub	epiphytic climber
Corona lobes	missing	present	present	present	present
Pollinaria orientation	pendulous	erect	almost horizontal	erect	erect
Pellucid margin	present	present	present	present	missing
Pollinia shape	round	oblong	almost squared	square	clavate
Caudicles	long, ribbon-shaped	unwinged, flattened	unwinged, flattened	short, winged	long, ribbon-shaped
Retinaculum	small, narrow, oblong	oblong-ovate	rhomboid	almost round	small, narrow, oblong

VIETNAM. **Nghê An:** Co Ba, Ke Nhe, 14 May 1914, *J. F. Fleury 32504* (P).

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Lectotypification of Three Species in the Fern Genus *Pteris* (Pteridaceae) from China

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ABSTRACT. Based on specimen and literature studies of the fern genus *Pteris* L. from China (Pteridaceae), three species are lectotypified: *P. dalhousieae* Hook., *P. esquirolii* H. Christ, and *P. henryi* H. Christ. Distribution for *P. dalhousieae*, which is not found in China, is also provided.

Key words: China, Pteridaceae, *Pteris*.

Pteris L. (Pteridaceae) is one of the largest genera of monilophytes, with approximately 300 species distributed widely in temperate, subtropical, and tropical regions of the world, extending to the south in China, New Zealand, and Tasmania, west to South Africa, north to Korea and Japan, across the United States, as well as the Mediterranean region of Europe (Copeland, 1947; Tryon & Tryon, 1982). About 55 species are recognized in the United States (Tryon & Tryon, 1982), 50 species and seven subspecies are distributed in the Indian region (Fraser-Jenkins, 2008), and 66 species have been reported for China (Wu, 1990), concentrated in South and Southwest China.

Apogamy is common in *Pteris*, and apogamous *Pteris* species often hybridize with members of a common or different complex. This is one of the characteristics leading to *Pteris* being considered as one of the largest genera of monilophytes (Walker, 1962). However, this causes taxonomic confusion, because numerous *Pteris* species are morphologically quite similar and the dividing lines among these taxa are questionable. Therefore, a comprehensive systematic revision of *Pteris* is necessary.

After critical study of the relevant protologues and type collections of Chinese *Pteris* species, we found that single collections were not designated as holotypes for three names, *Pteris dalhousieae* Hook., *P. esquirolii* H. Christ, and *P. henryi* H. Christ, in their respective protologues. According to Article 9.9 of the *International Code of Botanical Nomenclature* (McNeill et al., 2006), lectotypification is required for these three species. The epithet is corrected for the first of these names, following Rec. 60C.1(a) in the *Code*.

1. Pteris dalhousieae Hook., Sp. Fil. 2. 170, tab. 121A. 1858, as "dalhousiae." TYPE: [Malaysia] Malaya, Penang, s.d., *Lady C. Dalhousie s.n.* (lectotype, designated here, K-000444534; duplicate, K-000444535).

Two syntype collections (Malaysia, *Lady Dalhousie s.n.*; Indonesia, *T. Lobb 206*) were cited in Hooker's (1858) protologue of *Pteris dalhousieae*. Both collections are in good condition at K, with Lobb's collection from Java consisting of two sheets (K-000446315, K-000446316). However, one of the two sheets collected by Lady C. Dalhousie in Malaysia is selected as lectotype, since the taxon was named after Lady Dalhousie.

Distribution. Ding's unpublished thesis (2006: 23) reported *Pteris dalhousieae* from Hainan. However, after careful specimen examination, we found that the voucher *Team 75 Hainan 92* at SYS corresponded to *P. dissitifolia* Baker instead. There are no other published reports for the species in China, so we can assume *P. dalhousieae* does not occur there. The distribution for *P. dalhousieae* lies to the south, in Malaysia, Sumatra, Java, and Vietnam (Hooker, 1858; Holttum, 1954).

2. Pteris esquirolii H. Christ, Notul. Syst. (Paris) 1: 50. 1909, as "Esquirolii." TYPE: China. Yunnan: Ouanchay [Yuanchag], 5000 ft., s.d., *A. Henry 13320* (lectotype, designated here, P-00608469).

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Two syntype collections (*A. Henry 13320*; *Esquirol 286*, P-00608470) were noted in Christ's (1909) protologue for *Pteris esquirolii*, collected in different provinces in China—Yunnan and Guizhou—respectively, and both were deposited at P. Because some of the sterile fronds collected by Esquirol have been damaged and the collection is in poor condition, the collection by Henry is selected here as lectotype.

3. Pteris henryi H. Christ, Bull. Herb. Boissier 6: 957. 1898. TYPE: China. Yunnan: Mengtze, s.d., *A. Henry 9911* (lectotype, designated here, US-00055224; duplicates, MO-1858918, NY-00127511).

Two syntypes (*A. Henry 9911*; *A. Henry 9911A*, P-00608410) were cited in Christ's (1898) protologue of *Pteris henryi*. The duplicates at NY and MO differ in morphology from the US lectotype. The duplicates both have sterile and fertile fronds and resemble *P. dactylina* Hook. Their fronds are trifurcate or pinnate, with one or two pairs of lateral pinnae; pinnae are bifurcate or not. In contrast, the lectotype has only fertile fronds and shares many of the morphological characteristics of *P. henryi*. Its fronds are pinnate, with one to three pairs of trifurcate or bifurcate lateral pinnae. The *A. Henry 9911A* syntype at P looks like *P. actiniopteroides* H. Christ, with one or two pairs of linear-lanceolate or bifurcate lateral pinnae, while the lateral pinnae of *P. henryi* are always trifurcate or bifurcate. *A. Henry 9911* at US best represents the morphological characteristics of *P. henryi* and is thus selected as lectotype.

Indeed, the taxonomic delimitation of *Pteris dactylina*, *P. actiniopteroides*, and *P. henryi* has been confusing. *A. Henry 9911* (US-00055224, NY-00127511) was annotated as *P. dactylina*, with a label written as "—? *P. dactylina*." To further the confusion, there is also a label in R. C. Ching's hand, "— *Pteris actiniopteroides* Christ," on *A. Henry 9911A* at P. *Pteris actiniopteroides* was reduced to a synonym of *P. henryi* in *Flora of Yunnan*, but no explanation was given (Lu, 2006). Therefore, further study is required to elucidate the relationship of these three *Pteris* species.

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